



Acoustics Bulletin

July 1982 Volume 7 Number 3

INSTITUTE OF ACOUSTICS

Calls for Papers

The Meetings Committee of the Institute of Acoustics is always pleased to receive offers of contributions to any of its meetings. Contributions are particularly sought for the following:

Auditorium Acoustics

Edinburgh, 8 - 10 September 1982
Conference Organiser: Dr R K Mackenzie
Heriot-Watt University, 25 Chambers Street, Edinburgh EH1 1HU
(200 word abstracts as soon as possible)

Autumn Meeting

Bournemouth, 8 - 9 November 1982
Meeting Organiser: Dr J G Walker
ISVR, The University, Southampton
Sessions on Speech, Subjective Effects of Noise and Vibration,
Measurement of Acoustic Power and Intensity,
Machinery Noise and Vibration Control
(200 word abstracts as soon as possible)

Recreational Noise

February/March 1983
Meeting Organiser: Alan Baker
Motad International Ltd, Unit 2 Maverton Road, London E3 2JE
The Meeting will cover all aspects of recreational, DIY noise, etc

Inter-Noise '83

Edinburgh, 13 - 15 July 1983
Technical Sessions Organiser: Prof J B Large
ISVR, The University, Southampton
Sessions on all aspects of noise and its control
(200 word abstracts by 1 September 1982)

International News

International School on Physical Acoustics

This is a newly-created school which is jointly sponsored by the Italian National Research Council and the Italian Physical Society. It is planned to run a ten-day course every two years and is designed to benefit graduate students and young scientists who are engaged in physical acoustics research. The first school will be held this year at Erice, near Palermo, 30 November — 10 December, under the title of Basic Principles and Applications of Acoustic Waves. The lecturers will be acousticians from Europe and North America. Further details of the school can be obtained from the General Secretary, Professor A Alippi, Istituto di Acustica, 'O M Corbino', 1216 Via Cassia, 00189 Roma, Italy.

Ultrasonics International '83

The 14th meeting in this well-established series was originally to be held at the University of Surrey but will now take place in July at the University of Dalhousie, Halifax, Nova Scotia, Canada. General enquiries should be sent to Dr Z Novak, the Conference Organiser, Ultrasonics '83, PO Box 63, Westbury House, Bury Street, Guildford, Surrey GU2 5BH.

Canadian Acoustics/Acoustique Canadienne

This is a new journal published by the recently formed Canadian Acoustical Association which originally started some nine years ago as a newsletter under the title of *Acoustics and Noise Control in Canada*. With the change of title it has broadened its contents to cover all branches of acoustics. Further information concerning the journal can be obtained from the Canadian Acoustics Association, PO Box 3651, Station C, Ottawa, Ontario K1Y 4J1, Canada.

European Working Group on Acoustic Emission

The EWGAE holds its 9th meeting at Milano, Italy, from 29 September to 1 October 1982. Full particulars are obtainable from the Secretary, B Audenard, 52 Bld Galliéni, 92130 Issy les Moulineaux, France. □

RWBS



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July 1982

Volume 7

Number 3

Contents

	Page
Sponsor Members	2
President's Letter	3
Acoustics 82: IOA Spring Meeting	4
Acoustics at Bristol	9
New Elections	11
Pioneers of British Acoustics: H Lowery	12
IOA Annual Report	13
Abstracts: Design and use of Acoustic Test Rooms	16
Musical Acoustics Group: Joint Meeting with Institute of Musical Instrument Technology	18
Book Reviews	20
Letters to the Editor	21
Noise Control in Factory Buildings	22
Appreciations	23
Branch and Group News	24
London Evening Meetings	25
IOA Diploma Prize 1981 (continued)	26
Diploma Examination 1982	26
New Products	27
Institute of Acoustics Council 1982-83	27
IOA Meetings	inside back cover



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,
Institute of Acoustics
25 Chambers Street
Edinburgh EH1 1HU

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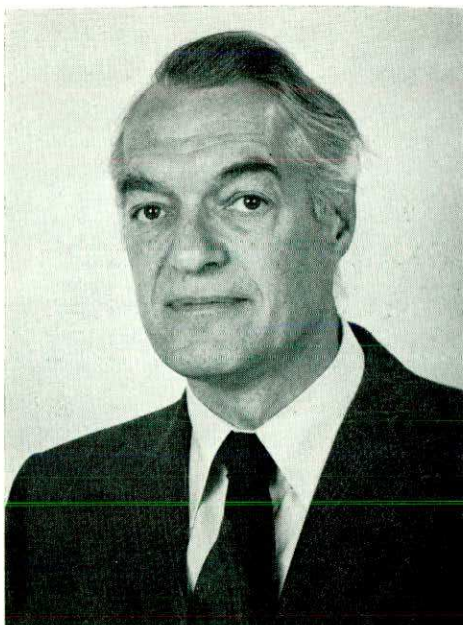
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President's Letter

Institute of Acoustics

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Dr F J Fahy
ISVR, Southampton University

Dear Member,

During the Spring Meeting of the Institute of Acoustics at Guildford I inherited the Presidency from Brian Clarkson, and am very conscious of the honour and the responsibilities that go with it. The ceremony took place during the Banquet, on 31 March, narrowly missing what I contend would have been the unsuitable date of 1 April! The 'chain of office' turned out to be a simple blue ribbon, but suspended from it is an elegant gold medallion bearing an impression of the head of Lord Rayleigh, similar to that appearing on the cover of the Bulletin a few years ago.

The occasion of writing this letter presents a golden opportunity for riding hobby-horses, and, as you may just have noticed, a great temptation for inappropriate metaphors and general meander. But I believe its most useful function is to bring relevant items from Council to your attention in a timely way. Council meets about four times a year, when among other matters it discusses reports from the five Standing Committees. These comprise Membership, Meetings, Publications, and Medals and Awards. The fifth is the Education Committee, the new name for the Diploma Advisory Board to mark the extension of its interests to such matters as Sixth Form Lectures. Thus a great deal of the organisational work of the Institute is carried out away from Council: at the Committees, Diploma Examination Board, Branches and Groups as well as individual work by the Honorary Officers and Edinburgh Headquarters Staff.

At my time of writing the last Council meeting was in February. One pleasing item concerned our discussions with Members in Hong Kong. A constitution has now been agreed, and the formal formation of the Branch authorised by Council. It is a real pleasure to welcome our first Overseas Branch, and to mark the initiative of those who made it possible. The same Council Meeting was the last for Professor Clarkson as President; and in addition Professor Peter Lord, then the Immediate Past President, retired from Council. I would like to salute them both and acknowledge their great contributions. Two other Council members are also changing their office: Professor Johns becomes President-Elect and Mr Bickerdike becomes a Vice-President. The new Council meets for the first time in May, still in the future as I write. I will not anticipate, except to crave their indulgence and co-operation — and your indulgence and co-operation!

Yours sincerely

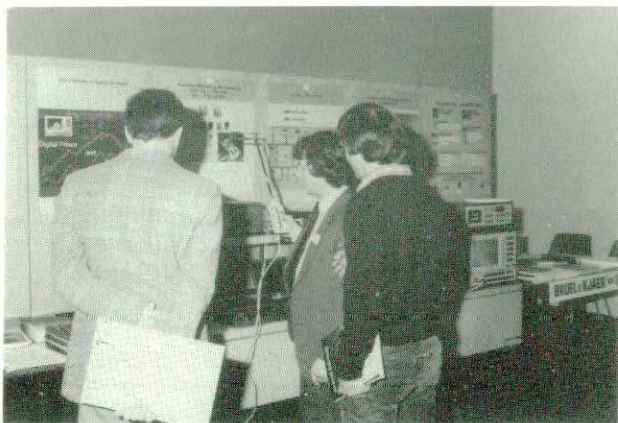
David Weston



▲ The exhibitors at Acoustics '82 wrestled with their cables and magic boxes . . .



▲ and the organiser of the conference, Dr John Bowsher, came along and photographed them . . .



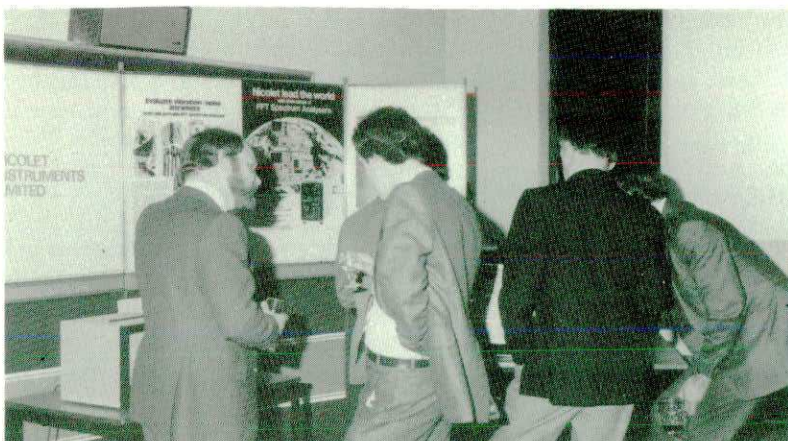
▲ well, perhaps it was worth all that trouble after all

Some familiar faces: a good turn-out of delegates for the Group Photograph. Why weren't ▼ you there? . . .

ACOUSTICS 82

SOME 134 delegates attended Acoustics 82 at the University of Surrey in Guildford. The 1982 Spring Meeting of the Institute lasted from 29 March to 1 April and major sessions were held on Environmental, Transportation and Propulsion Noise, Physical Acoustics and Ultrasonics, Signal Processing, and Subjective Effects. Probably because of the proximity of Guildford to London, comparatively few delegates stayed for the full three days, but those who did were full of praise for the amenities offered by the Conference Office and Catering Staff of the University. Praise was also expressed for the smooth operation of the audio-visual aids in the lecture theatres and for the general convenience of the theatres and their closeness to the exhibition rooms where tea and coffee were served every day. The trade exhibition opened on the Monday evening with the exhibitors' reception, which provided an informal introduction to the exhibitors and a chance to meet old acquaintances. During the conference delegates made the most of the opportunity provided by the well presented displays of keeping up to date with the latest developments in commercial equipment. Photographic coverage of





▲ and then the delegates turned their backs on the organiser . . .



▲ or else they turned their backs on the exhibits . . .

Meanwhile some of us were very hard at work on the registration desk (but it did become ▼ busier!)



IOA Spring Meeting

the trade exhibition was provided by the Conference Organiser, while Steve Heritage of the University of Surrey's audio-visual aids unit was on hand to provide a record of the rest of the Meeting.

One consequence of having relatively few residential delegates was that the Social Programme was not very well supported; this was a great pity as a comprehensive programme of visits and events had been arranged by Dr E A Johnson including, as a special feature of Acoustics 82, a short programme of talks about and tours of the historic town of Guildford. The Organising Committee had arranged this to coincide with a 'free' afternoon in the main programme so that all delegates could attend. This special attraction had, in the event, about 30 attendees and it seems that it would be worth while to try the experiment again at a future Spring Meeting.

The meeting was opened by the Pro-Vice-Chancellor of the University, and Professor K E Puttick of the Department of Physics also gave a short address of welcome. Then followed



◀ The two Presidents, both looking very cheerful

If David Weston was in fact suffering any qualms on assuming the presidency, the musicians of Surrey University helped to soothe ▼ them away





The Pro-Vice-Chancellor of Surrey University, Professor VS Griffiths, opened the Meeting

the first Invited Lecture by Mr L R Fincham who spoke most entertainingly and comprehensively on his experiences gained over some ten years of using digital signal processing techniques in the design and assessment of loudspeakers. The second Invited Lecture was given by Professor J Lamb on the first day of the meeting; it was devoted to a most stimulating review of the use of ultrasonic techniques to unravel some of the mysteries of the chemical structure of organic and other molecules. The other Plenary Lecture was the Rayleigh Medal Lecture, given after the Institute's AGM on Wednesday afternoon, in which Professor G Warburton described some of Rayleigh's original contributions to vibration theory which lay dormant for some years but have since been exploited.



Professor G Warburton received the Rayleigh Medal from the outgoing president, Professor B L Clarkson

Brief reports on each of the major sessions have been contributed for Environmental Noise by Mr R C Hill, for Physical Acoustics by Dr R C Chivers, for Signal Processing by Dr I Roebuck, and for Subjective Effects by Mr B C Grover.

Environmental, Transportation and Propulsion Noise

One of the most interesting features of the Environmental Sessions at Spring Conferences is the extraordinary diversity of topics covered. At this conference, Session A was no exception. Problems on the organisation of the session led to some slightly eccentric arrangements for the Chairmanship of its four parts, but this did not seem to reduce the interest and variety enjoyed by its delegates.



Mr L R Fincham presented the first Invited Lecture

The first part of the session dealt with aircraft noise but concentrated on the rather less glamorous aspects of this problem — airport noise and general aviation aircraft. John Large's double length 'topic' paper on airport noise provoked a good deal of thought and discussion and was followed by papers on general aviation noise. It was unfortunate that Dr Heng of the National University of Singapore was prevented by aviation problems from presenting his paper, on aircraft noise levels before and after conversion of a civilian airport to a military airbase, in its scheduled position in this part of the session. It would undoubtedly have provoked a far greater response from a more specialised audience.

The second part of the session dealt in the main with other aspects of planning noise and included papers on continuing research into subjective responses to aspects of traffic and railway noise, as well as a description of a novel attempt to produce a map of

existing noise levels in an urban area. At first sight this would appear to be an impossible task but the author showed that it was feasible and that it gave more reliable information than might be derived from the notional background levels in BS 4142.

Internal noise levels in a wide variety of different spaces were the subjects for the next part of the session and included the importance of early reflections in concert hall acoustics and the recent re-examination by the BBC of its own acoustic design criteria for studios. Finally delegates heard Dr Heng's rescheduled presentation together with studies of the acoustic characteristics of combustion chambers and a very interesting paper by Dr Shahin on the contribution to vibration in vehicles made by backlash in the transmission system.

Abstracts of the papers presented in this session appeared in the April issue of *Acoustics Bulletin* and no criticism is intended of those papers to which specific reference has not been made in this brief report. On the contrary all the papers made significant contributions to a wide-ranging and interesting session and our thanks must go to all the authors.

Physical Acoustics and Ultrasonics

The session started with three papers devoted to the localised measurement of sound intensity. S Gade (Brüel & Kjær) described a real-time digital intensity analyser based on a face to face microphone probe arrangement. His brief discussion of the acoustic characteristics of such an arrangement and their effect on the resulting intensity measurements was developed by P S Watkinson (ISVR) particularly with reference to the amplitude response. F J Fahy (ISVR) then described the ISVR Analogue Intensity Meter and its applications, with the conclusion that there is clearly much still to be done on the optimisation of field survey techniques and in the interpretation of the results. The accurate calibration of the systems was considered to be of particular importance. The fourth paper on audio acoustic detection was given by D M Treherne (Heriot-Watt, Edinburgh) on directional detection by resonant spatial phase techniques using a hemispherical shell in air as an example. This novel measurement technique, with an angular resolution of about two degrees, appears worthy of considerable further development.

The next group of papers was concerned with the calibration of ultrasonic transducers in the megahertz range. Mrs A Livett (NPL) reviewed progress at the National Physical Laboratory in absolute calibration techniques, and estimated an accuracy of approximately 10 per cent in total. Field radiation force techniques and hydrophone reciprocity gave good agreement at low megahertz frequencies but with some divergence as the frequency increased. R E Challis (Chelsea College, London) presented an analysis of piezoelectric elements in terms of transfer functions using Laplace transforms which, when re-structured using the z-transform, yield recurrence relationships permitting a relatively easy computation of the time domain response of the element. The experimental results obtained provided excellent confirmation of the method.

The fields from focused spherical cap radiators were discussed by J Adach (University of Surrey) who proposed that in using effective geometrical parameters to obtain an improved prediction of the field radiated by actual probes, the aperture radius could be assumed constant and only the depth of the cap varied. This was followed by a discussion by R C Chivers (University of Surrey) of the technique of ultrasonic time-delay spectrometry in transducer calibration. Considering both transmitter and receiver calibration, experimental results were shown illustrating its potential for continuous frequency relative calibration, directivity measurements and in the assessment of the degree of experimental precision needed.

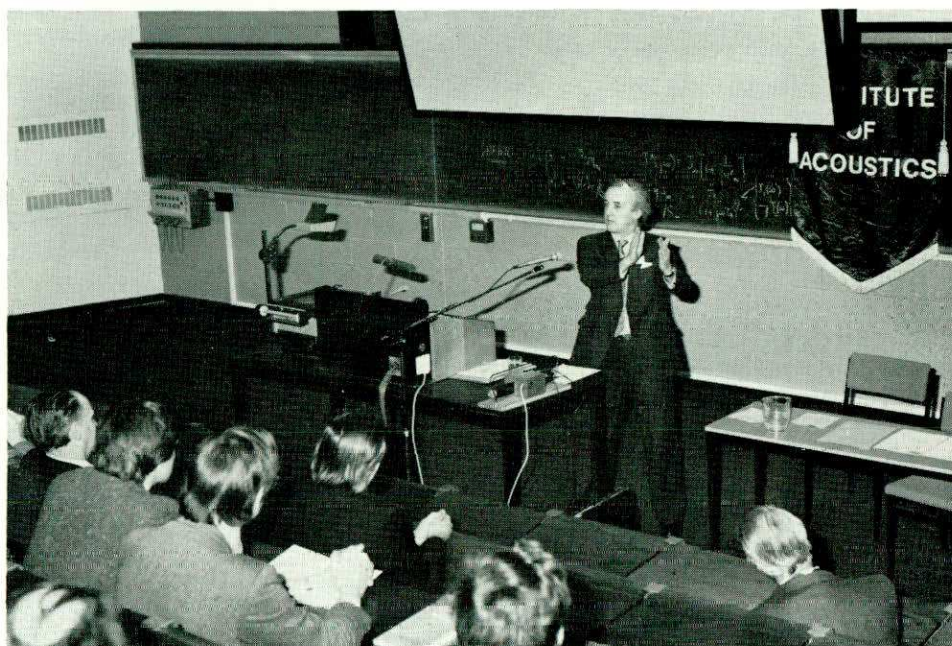
The application of ultrasonic techniques in non-destructive testing was the subject for a group of four papers. R E Challis described the effects of angulation of a plane target on the pulse-echo response of a transducer in terms of low pass filtering and the introduction of spectral lobes. The propagation of very sharp transients between two thick transducers was analysed in the next paper by the same author with good experimental agreement. The introduction of a real medium between the transducers was discussed by E Sabino (University of Surrey) with measurements of velocity and attenuation on suspension systems. Significant variations from smooth frequency and concentration dependencies were reported. These results were augmented by those of J D Aindow (University of Surrey) in a painstaking piece of experimental

work on the phase and amplitude fluctuations suffered by ultrasonic waves passing through suspensions. The preliminary conclusions concerning the high degree of scattering needed to produce significant fluctuations are of considerable importance but require further experimental confirmation.

The final papers of the session were concerned with the design and construction of an $\frac{1}{8}$ th scale model loudspeaker which C D Mathers (BBC) impressively demonstrated, and with the description of a powerful boundary integral and finite integral technique (P L Cousins, ISVR) for formulating the problem of mode coupling between a three-dimensional cavity and a resonant plate.

of reciprocity techniques and the signal processing algorithms which reduced the data to a remarkable match to the predictions. Discussion ranged from the esoteric merits of the modelling to the relative advantages of different drive transducers — with particular reference to a left foot Hush Puppy as a calibrated source.

Stuart Flockton then proffered a very neat comparison technique for removing the uncertainty of calibration from Impedance Tube Measurements on porous materials; the increasing use and awareness of these methods was reflected in the numerous queries on points of experimental technique. Tom Curtis then rounded off the session with a vision of a future of ever faster and cheaper transform devices, based



Professor J Lamb gave the second Invited Lecture

Signal Processing

Despite the rival attractions of the British Theoretical Mechanics Colloquium and the forthcoming Underwater Acoustics Group's specialist conference on the same subject, the Signal Processing session provided a wide ranging and well attended group of papers.

David Butler and John Chapman opened up with two linked papers on vibration and energy flow in ribbed curved structures, David concentrating on the theoretical aspects of why wave-number analysis should be used, and producing by sweeping assumptions a model of expected behaviour, while John described the experimental use

not on powers of 2 as in FFT algorithms, but on such concepts as the Chinese Remainder Theorem and Prime Number Radixes. This was an instructive glimpse into the extent to which computing devices have changed, and how Parkinson's Law applies there too — much more time is spent in the bureaucracy of record keeping than on the 'real work' of arithmetic operations.

Colin Ross gave the second morning a bright send-off by his description of antisound techniques and the associated signal processing. The science fiction is now thoroughly extracted from this subject, and its ability to reduce low frequency discrete tone

noise (and vibration, as Colin also showed) makes it complementary to conventional techniques. The lively discussion on this saw the first of Frank Fahy's multiple-choice questions, which grew in length and depth for the rest of the session. R Walker then discussed the development of a digital processing reverberation time measurement system, which had the overwhelming advantage, though so automated, of being amenable to providing the answer you ask for, and conquering it with its own preferred solution. The prototype black box, despite dire warnings of possible software bugs, provided a perfectly behaved live demonstration and so intrigued many of the audience that they preferred playing with it to drinking coffee.

Ian Roebuck then resumed his self-appointed role as Cassandra, and told dire tales of what can go wrong in finite time series analysis, urging his audience to be sure they knew what answer they expected before designing their particular Fourier Transform — that way they had some chance of getting it. After sowing doubt and confusion, he then offered the possibility of a way out by producing a universally convergent series of approximations to a 'true' spectrum. In unconscious anticipation of Professor Warburton, he remarked that, like much of acoustics, his results were known to Rayleigh but were only now being reinvented. Peter Lewis then concluded the session with a paper on sound transmission through walls and the possible inadequacies of steady state measurements as an indicator of effectiveness. The enormous differences in early arrival performance between different materials would have made the talk memorable, but all else was overshadowed by his description of the 'ultimate mousetrap' which was used as impulsive sound source but would obviously cope with even stainless steel rats. In at least this listener's mind, the enduring image of the conference is of the explosive charge replacing the cheese.

Subjective Effects

This session occupied the whole of the final day of the conference and was held as a joint meeting with the British Society of Audiology. Most of the papers were heard by an audience of about 25 who made up for their smallness in number by their enthusiasm and desire to participate in discussion.

Although greater numbers would have been welcome, the limited interest of the papers to those attending other sessions probably accounted for the restricted audience size.

The session organiser took the chair and had great pleasure in introducing a variety of papers covering a range of individual but often related subjects. The morning session began with the subject of low frequency sound. A paper by Graham Frost of Chelsea College dealt with the microstructure of the auditory threshold while Steve Benton examined some of the problems which arise in the assessment of low frequency sound.

In the first of two papers from the ISVR, Chris Rice discussed the results of an inter-laboratory study carried out for CEC of annoyance caused by impulse noise. In the second paper, Paul Darlington presented results of wind noise measurements related to the use of hearing aids. The morning session ended with a paper from Fuller and Whittle of the NPL and presented by Hilary Fuller who discussed an experimental programme to determine an objective procedure for measurements of speech levels.

The afternoon session comprised a group of papers concerned mainly with aspects of hearing impairment. Tom Troszianko from Professor Gregory's Brain and Perception Laboratory at the University of Bristol asked the question 'Amplitude compression for sensorineural deafness—is it worth it?' and decided that an unqualified yes or no answer was not feasible. The next paper was delivered by our overseas speaker Poul Lyregaard from the research laboratories of the Oticon Hearing Aid Company in Denmark. Poul discussed a test, which he described as simple, to measure frequency selectivity in hearing impaired subjects. There followed a presentation by Ian Summers from Exeter University whose topic of artificial impairment of frequency resolution included a taped demonstration of the effect of speech 'blurring' which he proposed as a simple model of hearing impairment. The demonstration provoked a lively discussion.

Interest at this point turned to the training of hearing impaired children, with Edith Gulian from Professor Fallsides Engineering Department at Cambridge University assessing the value of visual feedback in the acquisition of frication. The session ended with a mainly theoretical account of

speech perception by Jeffrey Bloom of the Polytechnic of Central London who examined some of the possibilities for its enhancement by the use of digital processing.

At this point the Chairman had pleasure in drawing an informative and interesting day to a close and a now slightly depleted audience retired for well-earned refreshments. The day had passed smoothly much to the credit of John Bowsher and his aides who had taken care of all the so necessary practical arrangements.

Two (of three planned) Technical Visits took place on the first afternoon of the meeting; the one to the Institute of Oceanographic Studies had to be dropped owing to lack of support. However, the visits to the National Gas Turbine Establishment and to the National Physical Laboratory were most useful and enjoyable. About 24 people went on the technical visit to the NPL, which was very well organised by Dr M E Delany. The trip included visits to groups at the NPL involved in acoustical and audiological standards, noise, and standards in medical ultrasonics. The visit to the NGTE, organised by Richard Pinker, consisted of tours of the Absorption Facility and the impressive large anechoic chamber, both of which are used in the measurement and control of engine noise. On the Wednesday evening the Conference dinner took place at the Seven Hills Hotel and provided a most enjoyable and relaxed evening. The carefully selected menu was complemented by the music of a small wind ensemble from the University of Surrey Music Department. After dinner speakers included our Presidents, old and new, and guests of honour Professors G Warburton and K E Puttick. □

J M Bowsher

Material for the October issue of Acoustics Bulletin should reach Mrs F A Hill at 25 Elm Drive, St Albans, Herts AL4 0EJ, no later than Tuesday, 24 August.

Acoustics at Bristol

The research in Acoustics and related subjects going on at the University of Bristol is of some variety and in several different departments. This is therefore described under appropriate headings as follows.

Department of Architecture

Most University Departments of Architecture include courses in Building Science, and Building Acoustics in particular, but it is generally agreed to be difficult to relate the essentially analytical approach of scientific research to the synthesising process of design. Most of the problems that designers have to solve are of the type which have many conflicting constraints, none of which have particularly strong influence but all of which require information which is not usually available in the early stages of design. For example, consideration of reverberation time does not exclusively determine the volume of a hall since it is perfectly possible to select from a range of volumes provided one can adjust the absorption coefficients of the surfaces. If a designer seeks advice about the volume he should provide for an auditorium, one can only give an approximate estimate, because so many other factors still remain to be determined. Many architects attempt to come to terms with this problem by seeking 'stereotype' forms of solution. That is to say, they look for precepts or example buildings which they can follow, without necessarily analysing the particular situation. It may well be that this is the only form of design-aid that architects can work with; it is certainly the only way they have worked in the past. However, most building scientists believe that it should be possible to frame descriptions of the behaviour of buildings in such a way that the designer can adopt a more analytical approach to investigating the consequences of his decisions. Reflecting this, the research at Bristol concentrates on the production of advanced functional design aids for buildings, which attempt to do this. Building science research should be directed towards helping designers; abstract research is seldom of direct use to them.

Acoustical research in the Department is concerned with noise in factory buildings and the acoustics of auditoria. The work on industrial noise control springs from an earlier interest in landscaped office acoustics, that is, in the nature of the sound field in large flat spaces, with low impedance sur-

faces. A simple computer model has been devised which simulates the steady state sound field in an industrial building containing a large number of identical sources, and it has been used to predict the effect of absorptive treatment. It had been assumed that absorptive treatment would be ineffective for reducing the noise exposure of workers since they are mostly inside the room radius when operating machinery. However, it turns out that for a space containing a large number of identical noise sources, the effective room radius becomes very small. The research into factory noise control by this means is therefore continuing.

The interest in auditorium acoustics has been of long standing. The development and application of tenth-scale acoustic models has been studied since 1966, see Figure 1. These models have proved to be somewhat difficult to apply as design aids for particular buildings because their construction time does not mesh well with the progress of the design project. However, they make an excellent research tool for the investigation of design criteria.

At present the research is mainly concerned with the effect of ceiling shape on criteria such as early decay time and spatial responsiveness, and with studying the inter-relationship between the many criteria that have been proposed for guiding the design of auditoria. In addition, an attempt is being made to improve the availability of the scale-model technique for design by working towards larger scale factors (smaller models).

In addition to these longer-term research activities, two or three small research contracts a year are undertaken on specific noise problems. There is also an interest in the development of software for micro-computers to be used by architects during design. There is a comprehensive course on building acoustics for undergraduates, and micro-computer programs are applied extensively in the teaching studios.

Department of Mechanical Engineering

Research in this Department is in the hands of Dr Bob Adams who is conducting work in both Structural Dynamics and Acoustics.

One aspect of the work concerns measuring the damping and dynamic modulus of a variety of materials at temperatures down to liquid helium (4°K). The materials concerned are

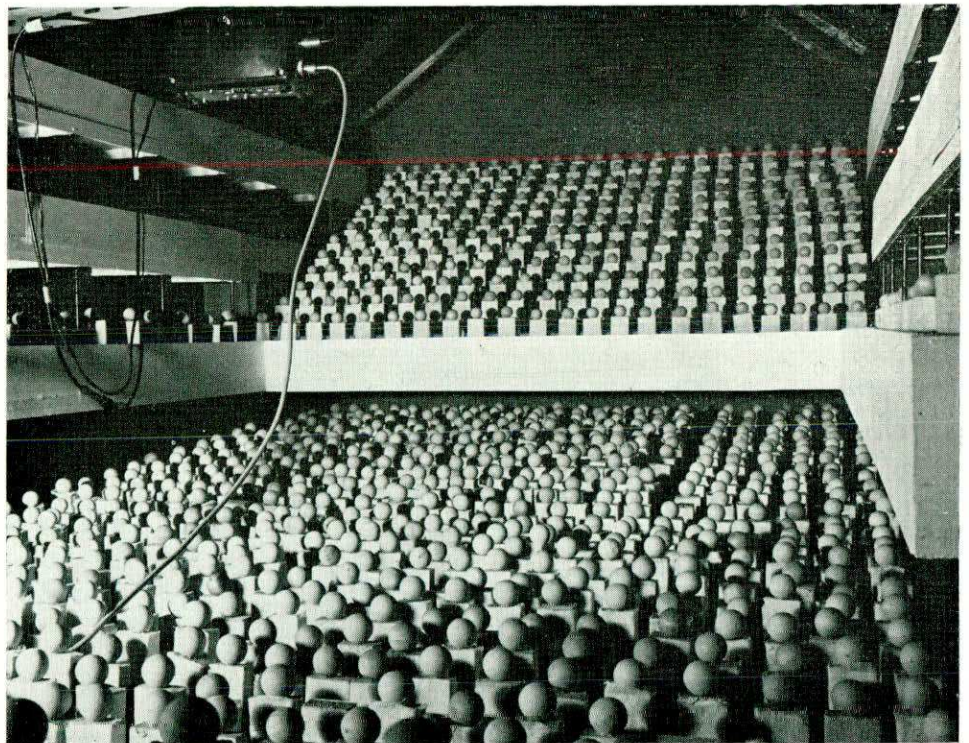


Figure 1 Acoustic scale model of a proposed concert hall for Bishop's Stortford

principally those which are candidates for inclusion in superconducting electrical machines and for which there is the likelihood of a vibratory environment. It is important here to understand the energy dissipation parameters for the materials so that predictions may be made concerning the level of refrigeration necessary to overcome these effects. Also, catastrophic results can arise from small rises in temperature caused by hysteretic vibratory heating since the specific heat of some of the constructional materials becomes very very small at these low temperatures. Typical materials are stainless steels, copper, composites, and super-conductor alloys. The work is supported by the Science and Engineering Research Council.

During the last few years, one of the major areas of activity has been a study of the damping and dynamic elastic moduli of high performance composite materials (carbon fibre reinforced plastics and glass fibre reinforced plastics). A range of fibre and matrix properties, such as fibre orientation, fibre volume fraction, temperature, and the effects of humidity has been studied. In addition, the variation of damping with cyclic stress and with temperature have also been considered. There is a number of published papers on this work.

Recently, some apparatus last used fifteen or so years ago has been resurrected so as to reactivate work on the damping of metals at sonic and ultra-sonic frequencies in the range from 1 - 20 kHz. In addition to the damping studies, it is hoped to take this work further towards the study of fatigue under high frequency conditions.

One of the major areas of research in the last few years has been on the possibility of using vibration measurements for the detection, location and sizing of defects in structures. This work has been applied both to metallic structures and to those made from composite materials. A local defect causes a reduction in stiffness and an increase in damping. Either of these parameters may be associated with changes in modal frequencies and damping and hence may produce information, by a mathematical model, for the damage detection technique.

A final topic on dynamical research concerns the impact loading of adhesive joints. In this work, the properties of adhesives in their bulk form have been examined at different rates

Sound propagation in atmosphere for typical atmospheric conditions

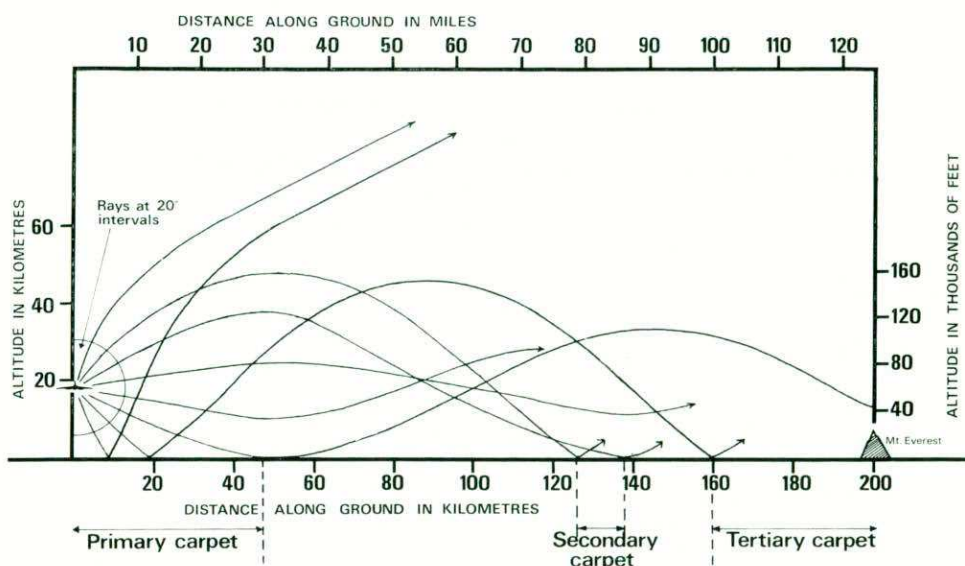


Figure 2

of straining and the performance of adhesive joints and built up tubes under impact conditions has also been studied. The project is associated with the crash-worthiness of adhesively bonded structures.

Recently, Dr Adams, in collaboration with a colleague Mr J A Bones, has been studying the mechanics of stringed instruments, particularly the cello. They have been looking at the

vibration and acoustic frequency response with the object of establishing the mechanics of energy transfer within these rather complicated structures. The work is, as yet, in its infancy.

Finally, there is the well-known work on sonic booms which unfortunately has not been published in the usual way. In 1977 Dr Adams became a media figure when his explanation for 'bangs in the night' received wide-

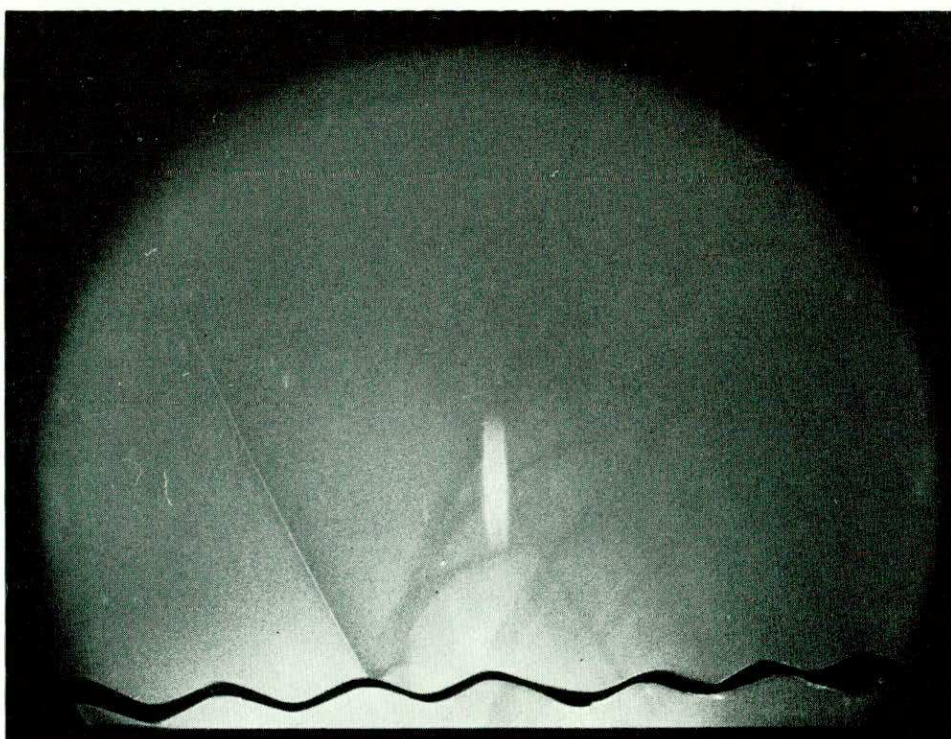


Figure 3 Schlieren photograph of a shock wave reflected from a corrugated surface.

ACOUSTICS ENGINEER

We are looking for an experienced engineer qualified in acoustics to take full control of our existing acoustical department.

The applicant should have both a theoretical and practical approach to architectural, industrial and building services acoustics, including the control of structure-borne sound and vibration. Some experience in the design of Public Address and Speech Reinforcement Systems is desirable. The applicant should also be able to provide advice to in-house engineering groups on the provision of appropriate sound attenuation and vibration isolation, etc, at the design stage.

In addition, the applicant should be experienced in dealing with industrial hearing damage claims and attendance in court as an expert witness. This will involve an appreciable amount of travelling in the UK.

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spread radio and TV coverage. These bangs coincided with the arrival of the evening Concorde from Washington and Dr Adams and colleagues were able to explain how they came to be heard up to 100 miles from the track of the aircraft. Figure 2 indicates how this can happen. Last year, the effect of the bouncing of shock waves off a corrugated surface was investigated, see Figure 3. This was done both mathematically and experimentally and produced some interesting results. The object of the exercise was to see whether the surface of the sea caused much scattering of the sonic boom from Concorde. This work is continuing.

Other research in the University

Professor K H G Ashby of the H H Wills Physics Laboratory has developed a technique based on the application of pulsed light emitting diodes to the visualisation of ultrasonic wave fronts in the detection of defects in opaque solids. The technique depends on the use of the LEDs as a short duration stroboscope with sufficient intensity to reveal the photoelasticity associated with ultrasound in transparent solids. A beam of ultra-

sound passes through an opaque solid where it is scattered by defects or holes. The scattered wave then passes into a transparent quartz layer, where the acoustic stresses generate photoelastic birefringence, illuminated by pulses of light of the same frequency. The frequencies used range from 2 to 4 MHz and the resulting fringe patterns can be used, for example, for non-destructive testing for holes and defects in the test solid. The technique is being further developed to improve background light immunity and clarity.

Tom Troschianko in The Brain and Perception Laboratory has been investigating the use of automatic gain control in hearing aids, by means of carrier clipping. The acoustics signal is used to modulate a radio frequency carrier which is then amplified and clipped. Demodulation produces a compressed waveform without the harmonic distortion which is associated with direct clipping. This makes it possible to amplify quiet signals without overloading the ear with very loud sounds. □

A J Pretlove
B Day
R D Adams

NEW ELECTIONS

At its meeting on 27 May 1982, Council approved the following elections.

Fellow

R C Chivers	C S Waters
H A Slyper	

Member

J M Ace-Hopkins	J G Miller
J F H Bodycombe	J J Morrison
N M Brooke	C P R Peacock
J E Craske	R E Richards
D F Edge	S G Rogers
R J Griffiths	R A Sargent
W J Hegarty	M Sullivan
W K W Hong	J R Trinder
K Irish	R G Tyler
C S Johnson	P J Watkins

Associate

P H Brassington	P Mason
P Broadbent	B G Olding
P Buckley	N L Olsen
B Carnell	M Y Poon
M H Dawson	S J Richmond
M Faulkner	S M Room
J H Fricker	G Seal
D Haines	J E Swistek
B G S Heywood	M S Thelner

Pioneers of British Acoustics

H Lowery (1896 - 1967) :

Physicist, organist and music historian

It is only within recent years that the discerning musician has begun to appreciate the value of some acoustical knowledge. This state of affairs has been in part attributable to earlier writers of acoustics books for musicians over-stressing the mathematical and physical concepts. The small volume of ninety pages written by today's Pioneer, Dr Harry Lowery, entitled A Guide to Musical Acoustics, initiated a more practical approach to the problem. He involves the broader aspects of acoustics such as psychology, the nature of musical scales, the role of the ear in musical performance, etc.

THE PRESENTATION in fact is indicative of the author's own experience in music-making. The charm of the book is enhanced by appropriate quotations at the beginning of each chapter. Under the chapter heading *Music and Acoustics* we find a quotation from Clerk Maxwell, viz: 'The special educational value of this combined study of music and acoustics is that more than almost any other study it involves a continued appeal to what we must observe ourselves. The facts are things which must be felt: they cannot be learned from any description of them.' In this chapter Lowery introduces a section entitled *The Principle of Tonal Relatedness* in which he emphasises that it is the changes in the pitches of the notes of melody which are the musician's concern while the physicist is primarily concerned with the actual pitch values. It should be mentioned that Lowery had written an earlier book (1952) for a wider public under the title *Background of Music*.

Born in Cumberland, H Lowery was educated at Whitehaven Grammar School and at the Universities of London, Leeds and Manchester. His career in education started with an assistant lectureship in physics at Manchester University, followed by a lectureship at Bradford Technical Col-

lege and the Headship of the Pure and Applied Physics Department at UMIST. He was appointed the first Principal of South-West Essex Technical College (now part of N E London Polytechnic) in 1938 and he was particularly proud of its Great Hall and organ. He remained as Principal until his retirement in 1963.

To those of us who were privileged to know him, Dr Lowery was a model of humility and kindness and he was always more interested in helping others than in seeking personal gain. His interest in education was long abiding and it was the marriage of art and science that made him an international figure in musical acoustics. Moreover it meant that he was as active in retirement as in his working life. Harry Lowery was a great traveller and he made a grand tour of the European continent to visit Baroque churches and to test the quality of the organs.

On this subject I would like to enlarge and to quote from an article by Lowery in the July 1959 issue of the American Guild of Organists Quarterly entitled *On Baroque Art and Music*. The term baroque is derived from the Portuguese, 'baroco', meaning an

irregularly-shaped pearl and it became used to signify the unusual, eccentric, bizarre, over-ornate and even ugly. It is now used to represent a definite period and movement in the social and artistic history of Europe and is applied to the interpretation of music of the Eighteenth Century. Only with the aid of the imagination and of the viewing of many examples of baroque architecture in cathedrals, churches and castles of central Europe can one begin to realise the splendour and ornateness of the baroque period (generally considered to be from the year 1600 to c1720). Its ending was hastened by the development of science. In the more modern approach to musical history reference is made to the contemporary social, artistic, intellectual and religious, etc, settings of the time and thus it was that the frequent embellishment by Bach of his organ works with trills and turns of all kinds was a common trait amongst the composers of the baroque period. To quote Lowery's words, 'The music of the Church provided in the realm of sound what the graphic arts presented to the eye'. Bach was extremely sensitive to the acoustics of the buildings in which he performed and he used the rough and ready method of hand-clapping as a preliminary test of reverberant conditions.

Lowery had a wide breadth of interests and devoted much of his spare time to the Trinity College of Music of which he was a Governor. He was also a Vice-President of the College of Preceptors, President of the Incorporated Association of Organists and an active member of the Royal Institution. Dr Lowery was prominent in the teaching of optics and was a Fellow of the British Optical Association. It is appropriate to conclude with the statement made in an obituary notice in the Times: 'For those who knew him there remains a gap which is greater than can be filled by a single man'. □

RWBS

THE INSTITUTE OF ACOUSTICS

EIGHTH ANNUAL REPORT

OF THE COUNCIL 1981

During the past year one of the major objectives of the Council has been to construct a coherent policy for the development of the Group and Branch structure of the Institute. Early in the year Mr Trevor Smith was appointed Vice-President with special responsibility for Groups and Branches. After thoroughly canvassing the views of the committees of existing and embryo Groups and Branches, a sub-committee, chaired by Professor Lord, produced comprehensive recommendations for the future growth and organisation of Groups and Branch structure, together with a model set of Rules, which have been published. The way is now clear for the formal establishment of the South West, North West and Yorkshire and Humberside Branches. Council agreed that, in future, Branch representatives will meet to nominate a Vice-President who will then have to be approved by Council.

Council has accepted the recommendation from the Diploma Advisory Board that it should be renamed the Education Committee and that its terms of reference be widened to encompass all matters of education related to Acoustics as they relate to Institute of Acoustics responsibilities and activities. The Chief Examiner, Dr R W B Stephens, has decided to resign at the end of the 1982 session of examinations. Council wishes to place on record the immense debt of gratitude owed to Dr Stephens for his services in this capacity since the inception of the Diploma course in 1977.

The responsibility for overseeing the meetings programme of the Institute has passed from Dr R Lawrence to Dr H G Leventhall. The enthusiasm and energy of Dr Lawrence as Vice-President and Chairman of the Meetings Committee has been largely responsible for the very great improvement in quality and quantity of meetings during the past few years. Dr Lawrence has replaced Dr Leventhall as Honorary Treasurer, which post, although daunting, has been made significantly less uncomfortable by the success achieved in stabilising the Institute finances since Dr Leventhall assumed responsibility in 1979.

1981 saw the retirements from Council of Professor E R Dobbs, Dr M E Delany, Dr T J B Smith and Mr R Harrison, whose services we recognised with appreciation. Professor Dobbs presided over two major developments in the history of the Institute:

the establishment of a professional membership structure and the inception of the Diploma in Acoustics and Noise Control. Dr Delany made a vital contribution to the successful development of the Institute as first editor of the Acoustics Bulletin. Council learned with pleasure of the award of an Honorary Fellowship of the Acoustical Society of America to Professor E J Richards, who is an Honorary Fellow of the Institute.

The number of registrants for the Diploma course rose to 158, of whom 75 qualified for the Diploma award. Two new colleges were approved to teach the Diploma course. The vibration module examination was sat for the first time. Appropriately, the very successful Spring Conference at Newcastle included a substantial content of structural dynamics presentations.

Following the demise of the Noise Advisory Council, the Institute has set up a Noise Advisory Group which will invite representatives of appropriate outside bodies to meet at the 1982 Spring Conference under the chairmanship of the President.

At the close of the year the total number of corporate and non-corporate members stood at 784 and 320 respectively. The number of sponsor members increased from 13 to 16.

STANDING COMMITTEES

The operation of the Institute is carried out by Council through the following standing committees: Meetings, Membership, Publications Education, and Medals and Awards.

Meetings

The main event of the meetings programme was the very successful Spring Conference and Exhibition, Acoustics '81, at Newcastle which attracted in excess of 200 participants. Another particularly successful meeting concerned Acoustic Emission and Photoacoustic Spectroscopy at Chelsea College. Two meetings on subjects of considerable current practical interest were those on Active Control of Noise and Vibration and Acoustic Source Location, both held at Birkbeck College. The issue of main Meetings Programme Proceedings has continued throughout the year. Groups and Branches have organised

a number of meetings which are noted in the relevant section. There has been a noticeable reduction in the average number of people attending one-day conferences in particular, which can probably be attributed to the current national economic situation, but which is nevertheless of concern. It is planned to hold an Autumn Meeting in Southampton in November 1982, and plans are progressing for Inter-Noise 83 in Edinburgh.

Membership

The Membership Committee met five times in 1980 and considered 230 applications from individuals, of which 209 were successful, and three for sponsor membership. Table 1 provides further details of membership statistics. Over the past year the committee has been considering the question of acceptability of various Diplomas for academic recognition under the Bylaws. An effort has been made to widen awareness among organisations of the possibility of sponsor membership, and to publicise the potential associated benefits, particularly to manufacturing companies. First year membership subscriptions will now be charged on a quarterly basis to avoid discouraging applications during the latter half of the year.

Grades of Membership	1980	1981	Applications in 1981	Successful Applications in 1981
Fellow	178	194	22	18
Member	531	590	110	86
Associate	256	294	98	98
Student	28	26	7	7
Total	993	1104	237	209
Sponsor	13	16	3	3

Table 1 Details of membership

Publications

Under the enthusiastic and skilful editorship of Mrs F A Hill the Acoustics Bulletin has continued to serve its main purpose of informing the membership of Institute activities and meetings, as well as carrying articles of general interest in the field of acoustics: this year speech research has been highlighted by the inclusion of several short papers on the subject. As far as possible, abstracts of, or reports on, all major main meetings and group meetings are presented. The cost of publication has been offset to a significant degree by advertising revenue.

The proposal to publish a Journal of the Institute of Acoustics has not been found to be practicable in the current financial climate, although the idea has not been abandoned. It is intended to produce

another volume of Medal Lectures to bring the series up to date. In future it is planned to encourage publication of these lectures in various Acoustics journals, or if appropriate, in the Acoustics Bulletin. Ultimately it is hoped to be able to make Medal Lectures available as preprints at the meetings where they are presented. The Institute has joined the Association of Learned and Professional Society Publishers, which facilitates world-wide advertisement of meetings.

Education Committee

Council reports with pleasure another successful year with 158 students taking the Diploma examination in 1981, of whom 75 qualified for the award of the Diploma; others were taking extra module courses. The Institute of Acoustics prize was awarded jointly to Mr J M Southwell, who studied at Newcastle Polytechnic, and Mr R A Sargent, who studied at Derby-Lonsdale College of Higher Education.

The projects were again generally of a very high standard and the Association of Noise Consultants prize was awarded jointly to Mr J M Southwell and Mr J P Blackburn of Leeds Polytechnic. The new vibration module was taught by three Colleges. The number of Health Officers qualifying for the Diploma in 1981 fell by about 20% compared with previous years, but the decrease was balanced by the number of industrial candidates.

Medals and Awards

The 1981 Rayleigh Medal was presented to Professor Uno Ingard of the Massachusetts Institute of Technology. An Honorary Fellowship was conferred upon Professor Fritz Ingerslev of the Technical University of Denmark. The Tyndall medal was awarded to Dr R K Mackenzie of Heriot-Watt University, Edinburgh. The A B Wood Medal and prize were presented to Dr Robert Spindel of the Woods Hole Oceanographic Institute.

BRANCHES

North East Branch

The Branch members expended very considerable time and effort to organise and host Acoustics '81, on the success of which Council wishes to congratulate them. Other meetings concerned Microcomputers in Acoustics, Music Recording and Bell Ringing and visits were paid to the Audiological Department of North Riding Infirmary. Two Diploma students were invited to give short talks on their project work, an innovation which attracted an attendance of over 40 people.

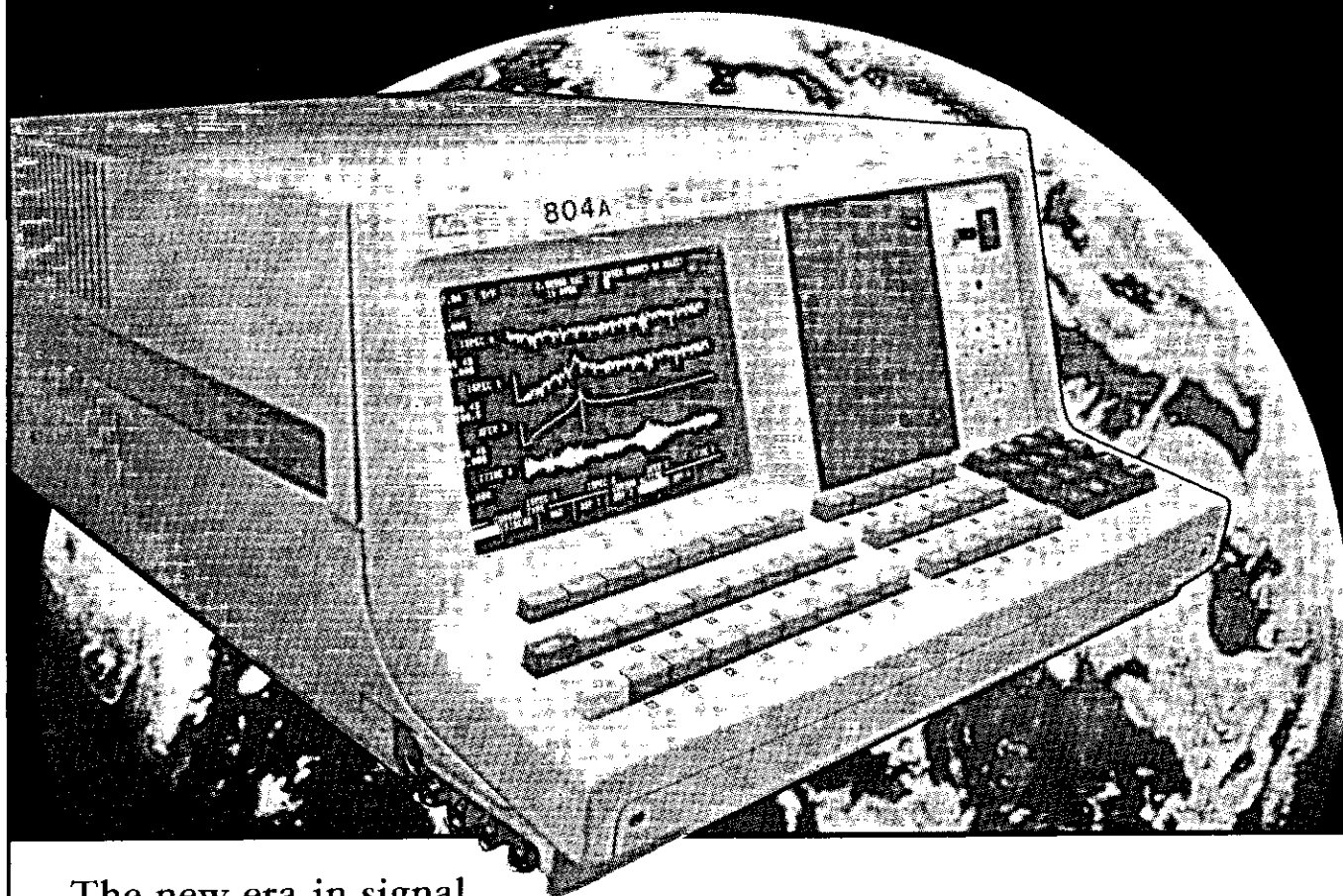
Southern Branch

During the past year the Southern Branch organised a series of evening meetings and a visit to Esso

continued on page 19

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Proceedings of The Institute of Acoustics - Abstracts

Design and use of Acoustic Test Rooms

28 June 1982, Birkbeck College, London

Use of Reverberant Chambers for Transmission Loss Measurements

S Grundy
Sound Research Laboratories

Abstract not available.

The Design of a Semi-anechoic Chamber for Indoor Vehicle Noise Testing at BL Technology

A H Middleton and A R Whatmore
Wolfson Unit, ISVR, Southampton

Reasons for requiring the facility; design parameters of the facility within the constraints of an existing building shell; philosophy of the selection of equipment, eg dynamometer, ventilation system; the noise problems encountered and their solutions in theory and practice; the performance achieved by the completed facility.

Precision Methods for Determination of Sound Power Level

Dr rer nat H Schmidt
Grunzweig and Hartmann Montage,
Frankenthal

The publication of sound power levels of machines is becoming mandatory. This value together with its frequency analysis is the starting point for the development of quieter machines as well as the acoustical design of the environment and specification of noise control requirements.

For precision sound measurements two diverse test methods are used, ie the reverberation room method according to ISO Standards 3741 and 3742 and the free field method according to ISO Standard 3745 in anechoic or semi-anechoic rooms.

The reverberation chamber method offers some advantages with broad band noise. With narrow band or pure tone components a significant investment on measuring is required.

An anechoic facility is necessary to determine the following:

- 1 Discrete noise sources in a complex source or machine;
- 2 Directivity factors;
- 3 Rapidly changing sound pressure levels, eg impact noises;
- 4 Work station evaluations.

For the reasons above, anechoic chambers are being installed more frequently in mechanical and technical development centres. This is besides the facilities that are used for the testing and calibration of

electroacoustic devices as well as for audiological and auditory/psychological research.

The principles of construction are discussed and details of the design described. Information is also given, derived from the installation of several hundred anechoic chambers. In the achievement of the required free field conditions, various problems encountered during construction are illustrated.

New Instrumentation for Acoustic Transmission and Absorption Tests

R D Ford and G Kerry
University of Salford

Since 1964 the University of Salford has been carrying out measurements of Sound Reduction Indices, Sound Absorption Coefficients, and Impact Insulation Improvement, in a Reverberation Suite built to both British and International Standards.

Both commercial and research testing is carried out, demanding not only a high measurement accuracy and repeatability but also a degree of flexibility in measurement technique.

The major problem in the early years was the length of time necessary to complete each measurement—a laborious procedure with the type of equipment then available. In the early 1970s the introduction of real time analysers considerably speeded up the process and improved reliability particularly at lower frequencies but RT measurement was still tedious. A reverberation processor was developed, in advance of the commercial units now available, and used successfully for a number of years until superseded by a computer controlled digital frequency analyser. More recently the system has been extended to include multimicrophone arrangements in both rooms, fully computer controlled incorporating unique calibration facilities and low noise power supplies.

The paper will outline the development of the system, the problems encountered, and discuss the safeguards built into the test programmes to ensure accurate and repeatable results.

Engine Noise Test Cells — Are Special Rooms Still Needed?

B J Challen and M D Croker
Ricardo Consulting Engineers plc

The problems of vehicle noise reduction have required the accurate measurement of engine noise for some years now. There has been considerable debate on whether anechoic or reverberant test environments

should be used. In most cases anechoic conditions have been adopted in order to provide the required amount of accurate information. In recent years the use of reverberant test facilities for engines and vehicles has been advocated once again. This paper reviews some of the requirements for noise reduction work in both the engine and vehicle areas from the engineer's point of view and contrasts these with what is required for legislative criteria.

Recent developments in the practical measurement of acoustic intensity have a considerable potential impact on the noise reduction process. How far the application of this technique in replacing and augmenting conventional methodologies may be taken is discussed and various results reviewed.

The Design and Use of a Miniature Anechoic Test Facility and an Outline of Design Constraints Governing Audiometric Test Facilities

C R Nicholas
Industrial Acoustics Company Ltd

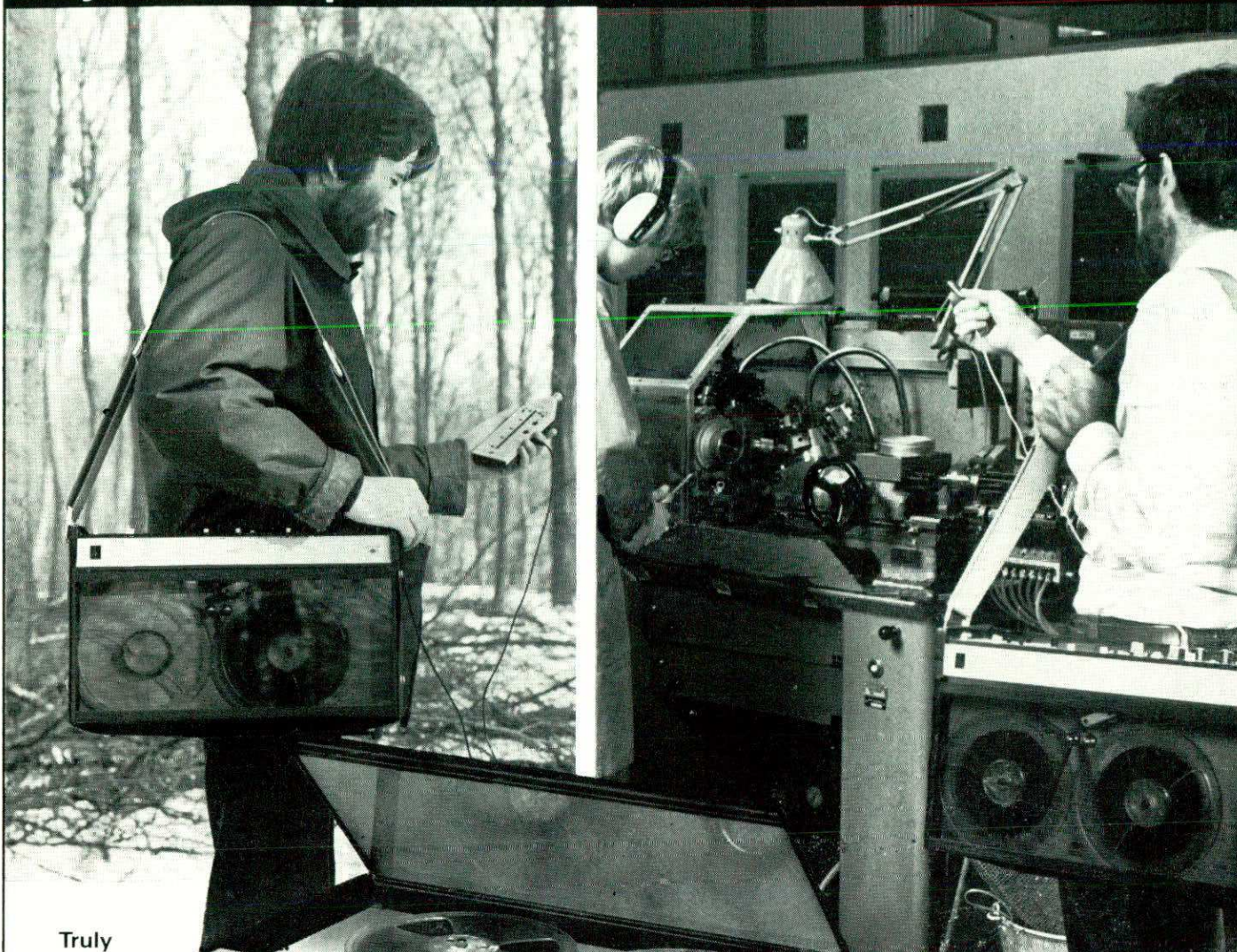
This paper will outline the design and construction of a miniature Anechoic Chamber, which was initially designed to meet one client's specific requirements, and its growth and development into a compact research and production test facility designed for use in Medical Engineering, Manufacturing and Laboratory environments.

We will discuss the detailed design and construction of the chamber covering the construction of the casing from an acoustic and structural point of view, the design of the unit to allow ease of operation, the vibration isolation to preclude effects of structure borne noise on the internal environment, the internal absorption characteristics of the chamber and how these were achieved, the fixing and placing of the object within the test area, the selection and adaptation of an internal noise source for the chamber so that tests may be performed on items requiring a well defined acoustic environment, so that the evaluation of acoustics to electrical energy output, of transducers and their associated components may be evaluated and the effects of the casing and housings established. We shall also discuss the application and practical limitations of such equipment particularly in the areas of current and impending legislation and standards.

We will conclude with a practical review of the Department of Health and Social Security design constraints for Audiometric Test Facilities together with field performance of a typical installation.

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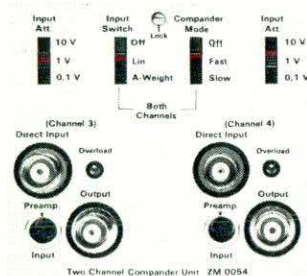
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Musical Acoustics Group: Joint Meeting with Institute of Musical Instrument Technology

A one-day meeting was held jointly with the Institute of Musical Instrument Technology on Tuesday 18 May at the London College of Furniture. After a welcome by the Principal of the College, the first paper was given by Leslie Jones of the 'home team'. He spoke on the diversity of keyboard actions in the fifteenth century and described his work on the analysis of the writings of Arnault of Zwolle, a fifteenth century Flemish commentator and informed observer of contemporary music. Four keyboard actions of varying degrees of complexity were described and some solutions suggested to the tantalising mechanical puzzles presented in the original writings. One of the actions seemed to be for a striking, rather than a plucking, instrument and the suggestion was that this could perhaps pre-date by two and a half centuries Cristofori's invention of the piano.

The next speaker was Edgar Brown of Chelsea College. He spoke on sound transmission in woodwind instruments and gave first a résumé of the elementary theory of wave propagation in tubes leading to a prediction of the resonance frequencies of an instrument. Perturbations to simple bore shapes were then considered and methods of calculating the position and dimensions of tone holes outlined. The properties of a set of open tone holes as a frequency-selective transmission line were described; such a portion of the tube of an instrument was influential in controlling the tone-quality. A 'neo-baroque' flute, having the basic simplicity of the modern Boehm flute, was demonstrated to show the degree to which intonation and tone-quality could be achieved directly from calculation of the instrument's proportions.

Turning to the question of tuning temperaments, David Smith of the London College of Furniture described his work on the application of computer software to their practical implementation. He first described the bases for the main groups of temperament systems. He then set out briefly the calculations to achieve the semi-tone multipliers and other numerical values for a given tuning system,

particularly the beat rates for each interval necessary for laying the bearings in practice. All known historical systems were embodied in the programs, but Werckmeister seemed to have struck back during the following demonstration since the printer attached to the computer refused to record the results.

After lunch, Kenneth Macfadyen of Birmingham described some of his work on the loudness distribution in ranks of organ pipes. This involved the direct measurement of loudness by comparison of the organ sound with a test tone at the ears of a listener. The stops of a diapason (principal) chorus were investigated for a North-German baroque organ and for both early- and late-romantic English organs. The degree to which the loudness distribution gave clarity to the upper notes in the presence of masking from the lower was investigated. It was interesting to observe that the loudness of notes played on the full chorus of the late-romantic English organ remained practically constant throughout the compass.

Gareth Roberts of University College, Cardiff, gave a résumé of the development of theoretical methods for determining the resonances of the solid resonators used in musical instruments. Ranging from Pythagoras and Mersenne for strings and Chladni for plates, the development of mathematical techniques through Rayleigh and Timoshenko to the finite-element methods currently in use was outlined. He described the application of these latter methods in his own work to handbell-like shells, to plates having anisotropy similar to wood and to various plate shapes characteristic of stringed instruments. In one of the later applications of the technique, even the *f*-holes of a violin were modelled. Evidence of the success of the theoretical modelling was given by the holographic experiments of his colleague Bernard Richardson who gave the final paper.

A major part of the art of guitar making lies in the correct placement of the instrument's resonances. A powerful laboratory technique in

investigating the modes of the plates of the guitar is holographic interferometry which enables the modes to be identified at plate displacements representative of those under playing conditions. The experimental arrangements and many striking examples of the results were shown. The change in the resonances as the instrument was assembled were followed as was the interaction of the plate resonances with the air resonance which appears when the instrument is complete. The effects of mode coupling and string polarisation on rate of vibration (and hence sound) decay were discussed. Novel features in the placement of the wood resonances and the advantages accruing from these were described.

The meeting was well supported by members of both Institutes. Thanks are due to the London College of Furniture for making us so welcome and to Terence Pamplin both for making the local arrangements and for his guiding hand from the Chair. □

Edgar Brown

Theory of Wave Propagation in Random Media

9-10 September 1982, Cambridge

Problems related to the propagation of waves in random media are of great interest in the fields of solid state physics and acoustics. However workers in these two areas seem to take different approaches to these problems and there is a lack of communication between them. To promote such communication it is intended to hold a short interdisciplinary meeting in Cambridge during September 1982.

Speakers include Sir Nevill Mott, D Weaire and J B Pendry who are solid state physicists and M Heckl, M Howe and B Uscinski who are acousticians. These talks will be given on the first day. The second day will be reserved for discussion; there will be no formal session devoted to contributed talks.

Further information may be obtained from: Dr C H Hodges, Topexpress Ltd, 1 Portugal Place, Cambridge CB5 8AF. □

continued from p 14

Fawley. The venues of the meetings were split between Southampton (3) and Portsmouth (3), together with an informal social evening at Portsmouth. The attendance for these meetings has varied from over seventy for the *Acoustics for Everyman* forum at Southampton to only eight, although a more typical figure is fifteen.

Southern Branch now face a problem in that the Chairman for the last three years, Dr J A Powell, and also Mr P D Wheeler, feel unable to continue because of pressure of work. So far it has not been possible to fill the vacancy for the Chairman, which the committee felt should be filled by someone with close links with ISVR, particularly because the link through Mr Wheeler has been lost.

It was therefore agreed at the AGM of December 1981 that nominations for a new Branch Chairman should be sought and an Extraordinary General Meeting be called by the end of June 1982 to discuss the future of Southern Branch. The planned programme will in any case continue until June 1982. It is hoped that the EGM called for 24th May will resolve the situation and that Southern Branch will then approve the new constitution.

London Evening Meetings

Once again the L E M organisers have provided an excellent and diverse programme of meetings for the edification and entertainment of members in the London area, which contribution Council is pleased to acknowledge.

REPORTS FROM NEW BRANCHES

South West Branch

A successful initial fund raising meeting was held in conjunction with the Environmental Health Officers Association at one of the Plymouth hospitals. Later in the year a joint meeting was held together with the Department of Architecture of Portsmouth Polytechnic on the responsibility of the architect for the control of noise in buildings. Membership is growing and bringing with it a diversification of interests.

North West Branch

Three technical meetings were held on Hi-Fi, Transmission of Ground-Borne Vibration from Impact and Vibratory Piling, and Occupational and Industrial Noise Control. The President was invited to address the Branch in December on the Aims and Objectives of the IOA. A visit was paid to the Manchester television studios of the BBC. Membership is expected to increase substantially during 1982.

GROUPS

Speech Group

The major activity of the year was the participation in Acoustics '81, including an invited lecture by

Professor M Haggard on *Speech for Hearing or Hearing for Speech*. This was followed by 14 contributed papers. In September a one-day meeting on Speech Aids for the Disabled was held at Bedford College, London. The final meeting, on Speech Production, was held at Oxford University. Members of the Group contributed a set of feature articles on Speech Research to the *Acoustics Bulletin*. Mr J N Holmes, who has chaired the Group for five years, retired from this office in 1981. Council wishes to acknowledge his sustained contribution to the Institute's interests in this field during that time. Total membership of the Group is about 50, but the proportion of corporate members is smaller than might be hoped.

Musical Acoustics Group

The major event of 1981 was the session on Musical Acoustics at Newcastle in the Spring which owed much of its success to the efforts of Dr J Bowsher. Thirteen papers were presented on a range of topics, including *Normal Modes of Bells* and *Timbre of Musical Instruments*. The participation of Dr Jürgen Meyer of PTB Braunschweig, who gave an Invited Lecture on *Acoustics and the Performance of Music*, and later made a delightful informal presentation on concert halls used by Haydn, was particularly welcomed. The Group was also pleased to welcome to the meeting Dr Judit Angster of the Hungarian Academy of Sciences. During the Conference a group visited the organ works of Messrs Harrison and Harrison of Durham.

In November a party visit was organised to the Bell Foundry of John Taylor and Co in Loughborough, and to learn about research being carried out on bells at Loughborough University, particularly in the phenomenon of 'bell warble', a matter of great practical importance.

Membership of the Group has grown to about 70.

Building Acoustics Group

A planned major involvement in the Autumn Meeting did not materialise because of the cancellation of this meeting. Plans are in hand for collaboration with the Musical Acoustics Group in 1982 and a number of other meetings are also being organised.

Underwater Acoustics Group

During the year the Underwater Acoustics Group has organised one technical visit and one conference. On 18th April 1981, fifteen delegates visited the Institute of Oceanographic Sciences at Wormley. Various members of staff gave informal talks about some of the current work involving underwater acoustics followed by a visit around the establishment.

A two half-days conference entitled *Advances in Underwater Acoustics* was held at AUWE, Portland

on 1-2 December, 1981. Fourteen papers were presented, four of which were from abroad. Included in the programme was the A B Wood medal presentation to R C Spindel of Woods Hole, USA, who then gave the Memorial lecture on *Ocean Acoustic Tomography*. In parallel with the conference a manufacturers' exhibition was held and attracted six firms. The conference was well attended with about 100 delegates.

Industrial Noise Group

No meetings were held.

Aerodynamic Noise Group

In abeyance.

ADMINISTRATION

Council wishes to acknowledge the efficient and courteous service provided by the Secretary, Mrs C M Mackenzie, and her assistants during 1981. The effective operation of the Institute depends critically upon the smooth functioning and availability of helpful advice which characterise the services provided by the Headquarters secretariat.

The Year Ahead

With the birth of new Branches, and the intention to strengthen the regional infrastructure of the Institute, Council look forward to a substantial increase of membership in 1982 and trust that these developments will prove to be of benefit to all members.

Book Reviews

Clay's Handbook of Environmental Health (15th Edition)

W H Bassett and F G Davies (Eds)

H K Lewis & Co Ltd
864 pp £30.00

To discover the breadth of an Environmental Health Officer's range of duties and responsibilities, although not necessarily the depth, one could do no better than read this latest edition of Clay's Handbook. The fifteenth edition since 1933, the book is a compendium of legislation, history, practical physics, biology, food technology and building science. In its 36 chapters and 851 pages may be found reference to abattoirs, bacteriology, chitterlings, dropsy, explosives, and so on to *Xestobium ruffovillosum* (death watch beetle) and Zyklon. The comprehensive index itself covers 30 pages and it is therefore not very surprising to find that noise is allowed only eighteen pages in Chapter 24, some of those being occupied by plates and figures.

There is little reference to acoustical theory of even the simplest kind. As may be expected, the law relating to environmental noise and its control is summarised, the principal legislation being the Control of Pollution Act, 1974, although European legislation is

also mentioned, as is the Land Compensation Act and its associated Regulations. Some space is devoted to a description of the more commonly encountered noise indices and to commercially available equipment for their evaluation. One might, however, question the wisdom of showing equipment from only one manufacturer, especially as the maker is acknowledged beneath each plate, complete with full Hounslow address!

As with other editions, the fifteenth has again been revised by W H Bassett (CEHO, Exeter) and F G Davies (ex-CPHI, Exeter) who are both examiners for the EHO Education Board. A certain amount of bias towards one city's noise control philosophy and practice is to be expected, but in a volume which is designed to be a training manual the space devoted to general noise surveys may be misleading to a student if presented uncritically. There are already too many people who believe that such exercises are easy, provided appropriate instruments are available, or that definition of a noise problem can be achieved solely by measurement of the physical parameters. I do not believe that these two gentlemen would themselves fall into that trap, but wish that they had seen fit to erect a few warning signs.

Such signs are evident in the section relating to criteria for the assessment of annoyance where it is acknowledged that 'some authorities . . . think that some of the adjustments prescribed in [BS 4142] are inadequate. . . .'. In relation to road traffic noise, problems caused by rain, wind and extraneous sources are acknowledged, although the shortened procedure described for the evaluation of L_{10} (18-hour) is not that recognised by the relevant legislation.

Aircraft, train and occupational noise are dealt with briefly and simple noise control remedies and measures are outlined. Control of noise on an area basis by planning and/or the creation of noise abatement zones are similarly described, and the chapter ends, as others, with a short list of suggestions for further reading. Reference is made in an earlier chapter to the provisions of the Building Regulations concerning insulation of party walls and floors. This is not a volume which will attract the interest of acousticians other than those who are tempted by my opening remarks, but will surely yet again find a place on the library shelves of every environmental health department. □

M S Ankers

Letters to the Editor

Dear Editor,

I have read Mr J Moir's report of the IOA Meeting *Noise nuisance assessment: BS 4142 reviewed and criticised* and feel that I must point out an error of fact where Mr Moir refers to the paper by Mr Flindell, now Dr Flindell.

Dr Flindell did not say that 'the degree of intrusion was not a function of the difference between the levels of intruding and ambient noises', as Mr Moir reports. What he did say was that 'the degree of annoyance was not a function of the difference between the levels of intruding and ambient noises'. His reasons for reaching his conclusions were clearly and carefully expounded in his paper. He was very careful to distinguish between the terms *intrusion* and *annoyance*. He defined the relevant terms as:

Intrusion: entering into a person's perceived world;

Annoyance: a general adverse response to any noise once it has intruded;

Background noise: whatever is left when an intruding noise source is removed.

Dr Flindell made it very clear that noise intrusion is necessary before general community annoyance can occur, but that intrusion alone is not sufficient to cause annoyance. He went on to state that current research is showing that general community annoyance depends far more on the absolute noise level than on the margin of exceedance above the steady background level. He referred to several field studies which indicated that source specific annoyance was related to the noise level of that source, and not to the degree of intrusion relative to background noise. He said that people's reactions may be influenced by the overall noise levels, such that they might be more annoyed by specific sources if their environment is generally noisy.

He also described results obtained in laboratory tests that illustrated how, at constant aircraft or railway L_{Aeq} , overall annoyance reduced as the noise intrusion of the aircraft or railway noise increased against background L_{90} .

He concluded that reducing the ambient noise or the steady background level, when the absolute level of a specific source was held constant, re-

duced overall annoyance. This was despite the fact that the intrusion of the noise source was increased by the reduction of the ambient or background noise level. There was a trend for *source specific annoyance to reduce as intrusion increased*. He felt that the results questioned the validity of an assessment methodology based on intrusion and which is adopted by BS 4142 and ISO/R 1996.

I believe that these conclusions are of fundamental interest in our understanding of responses to environmental noise and it is unfortunate that Mr Moir's comments do not give Dr Flindell's paper the credit it deserves. Indeed, the comments do grave injustice to a paper of considerable scientific merit.

Yours sincerely,

J G Walker

Dear Madam,

In his note on *Scheduled Helicopter Operations Outside London* (Acoustics Bulletin, January 1982, page 20), Chris Hill outlined some conclusions reached by the Inspector at last year's public inquiry into the proposed Milton Keynes heliport. His summary is broadly correct but as noise adviser to Milton Keynes Development Corporation on this matter I feel that it could be slightly misleading to members when read outside the context of the Inspector's full report. I would therefore like to offer a few points of clarification.

The Inspector, Air Vice-Marshall B P Young, indeed accepted the generality of our reasoning and stated that he was impressed by the extent of the safeguards in the Section 52 Agreement which was drawn up between MKDC and the Borough Council. The principal safeguards were an 'average maximum' (rather than peak) sound level of 78 dB(A) which was not to be exceeded at any dwelling, and a maximum of 60 helicopter movements (30 arrivals and 30 departures) in any one day. I explained in my evidence that these two constraints ensured that no home could in practice suffer a noise exposure greater than 34 NNI (calculated in the conventional manner) although the agreement actually specifies a qualifying limit of 37 NNI.

In addition, any individual helicopter type would be prohibited if it generated 83 dB(A) or above on more than 10 per cent of its movements.

On the subject of 'designated areas of outdoor recreational activity' it should be understood that when the Inspector stated that 'it seems to me that the regular intrusion of noise levels of the order of 75 dB(A) or more would be wholly out of place and at variance with the purposes of this designated public open space' he was referring specifically to this particular lakeside area (over which some helicopters would make their final approach at low altitudes) and not making any wider observation about helicopter noise and recreational areas in general.

Yours faithfully,

J B Ollerhead

Chris Hill replies:

John Ollerhead points out that the Inspector's comments should be related to the specific situation of that planning inquiry; my interest was in the possibility of applying the specific findings in the wider context. In the continued absence of a comprehensive British survey to test the reactions of British residents — and indeed park-goers — to the noise carpet produced by the regular overflights of non-military helicopters, the local planning authority is reduced (in the spirit of the recommendation contained in paragraph 20 of DoE Planning Circular 10/73) to making the best common-sense judgements it can in the light of 'all the available evidence' when assessing the impact of such overflights. I remain convinced that any report such as that produced by Air Vice-Marshall Young offers invaluable assistance to the local planning authority and represents 'another piece in the jig-saw puzzle of eventual understanding'.

Copies of the Inspector's report may be obtained from Ms D S Kahn, New Towns Directorate, DoE, 2 Marsham Street, London SW1P 3EB, price £4 payable to the DoE.

In fact I am informed by the Department of Trade that their long-awaited study into the reaction of people in the UK to the noise generated by overflying helicopters stands a good chance of going ahead this Summer. If this is indeed the case then I only hope that the results of the study are made available swiftly enough for them to be included in the long-overdue replacement to Planning Circular 10/73. □

Noise Control in Factory Buildings

IOA Meeting at Cambridge University, 26th May 1982

THIS WAS indeed a splendid meeting where both the weather and the setting of Darwin College complemented a stimulating programme. The large attendance of nearly 70 delegates caused a minor problem in that the modest ventilation system in the Colloquium Room was soon overloaded. Under the watchful eye of the first Chairman, Professor Peter Lord, windows were adjusted to provide a balance between the flow of fresh air and the ingress of casual traffic noise.

Mr Alan Dove of the Health and Safety Executive (HSE) started off the morning session by throwing the cat in amongst the pigeons. He suggested that acousticians are often more concerned with the means of achieving noise control rather than the desired ends. Mr Dove concluded that there is a need for acousticians to develop realistic methods for measuring machinery noise if duties are to be imposed on machine manufacturers. Furthermore, the development of easily applicable methods for the prediction of the effects of noise control measures is required.

Mr Keith McRae of Philips Industries described his approach to noise control in a large industrial company and noted that his paper had been sandwiched between what could be called 'the devil and the deep blue sea', namely the HSE and a leading acoustical consulting firm. Consequently he steered an unprovocative course through what he considered might be an acoustical minefield. He pointed out an amusing anomaly in the Code of Practice which states 'if the noise level and nature of the machine are such that operatives will normally be exposed above 90 dB(A) L_{eq} then signs should indicate that ear protection should be worn *and be permanently attached*'. Despite this anomaly he has found that the guidelines from the HSE provide a useful framework to help him in his difficult task of maintaining an effective noise control programme in a large company.

Mr Andy Middleton, manager of the Wolfson Unit at ISVR, conveyed the message that noise measurements are

not always the paramount factor in noise control. Common sense and a smattering of workers' psychology are very important. An interesting example was of a building shaped like a Dutch Barn which he came across in Spain. The curved roof caused acoustic focusing and workers near the focus were exposed to levels up to 118 dB(A)!

The second half of the morning session was devoted to prediction theories for determining the acoustical characteristics of factory spaces. The invited speaker, Dr Svetozar Jovicic from Müller-BBM in Munich, presented a lucid account of his theoretical work for predicting sound fields in factories. As a consultant he stressed the need for theoretical models to be easily applicable in actual situations and showed how his theory could be used with the aid of one design graph. Dr Jovicic then gave three examples where his theoretical predictions were compared with measurements in actual factories. Agreement was good in the case where the factory had a uniform distribution of machines (scatterers) but not so good where the distribution was non-uniform. He concluded that his prediction theory is valid in many cases but that more investigations are required including measurements in physical scale models. We are greatly indebted to Dr Jovicic for his presentation; his theoretical work is a milestone in acoustical prediction methods for factory spaces.

Mr Murray Hodgson of Cambridge University reported results of measurements of Reverberation Time and Sound Propagation in empty and fitted factories. He demonstrated the importance that fittings (machinery, etc) have on the acoustical characteristics of factory spaces. Mr Hodgson concluded by confirming that Sabine's theories are inapplicable in factories and added that, of the new theories available, Friberg's is of limited use whereas the Jovicic theory includes most of the observed effects.

Dr Elizabeth Lindqvist presented a very lighthearted account of her theories despite the fact that heavy mathematics were lurking below the

surface. Later she gave examples of the effects of varying various parameters of a factory space. A surprising effect is one which had already been mentioned by Mr Hodgson, namely that if the height of a factory is increased the sound level increases rather than decreases, particularly at large distances from the source.

If we consider that Dr Lindqvist's paper was mathematically rigorous then that of Mr Peter Wilson of Lucas CAV Ltd was diametrically opposed to it. However, many consultants were nodding approval as he revealed his simple-to-apply, rule of thumb methods for predicting sound propagation in factories.

The afternoon session was chaired by Dr Frank Fahy who invited Mr Richard Cowell of Arup Acoustics to present the first paper. Mr Cowell put forward an idea which appears to have a lot of mileage (or acreage) in it, namely the use of absorbent materials for factory envelope construction where thermal and acoustic properties are combined. He concluded that further studies are required to determine the cost effectiveness of this approach as opposed to traditional treatments for noise control.

Mr Brian Ross of HSE cautioned delegates that the Factory Inspectorate is stepping up pressure against noise offenders in industry and that in Scotland prohibition or improvement notices are being served at the rate of one a week. This is presumably good news for consultants although it stresses how important it is that noise control measures should be as cost effective as possible, particularly in the present stringent economic climate.

B Ross was quite properly followed by C Ross of Topexpress Ltd in Cambridge. Dr Colin Ross described the principles of a new method for reducing noise which might become 'reasonably practicable' in factories in the near future, namely active noise control. The first example he gave of an application of this technique was in the quietening of a jet engine in a Gas Board compressor station. Seventy-two loudspeakers were located in the exhaust stack which were driven by 12 kW of electrical power — probably one of the biggest 'disco' amplification systems around! A second example, more relevant to factory spaces, involved a combination of passive and active control to quieten a cutting and folding machine in a newspaper printing works.

The next paper was introduced by the Chairman as a double act by Mr Stuart Bolton and Mr Neil Baines of ISVR, which seemed appropriate as they were dealing with the absorption mechanisms of double panel roofs. Stuart Bolton described the theoretical aspects of a mathematical model developed to interpret the acoustical behaviour of this type of construction, whilst Neil Baines discussed experimental work conducted in order to verify the theory. They concluded that the sound absorption by this type of construction is due mainly to the dissipation of energy by the vibration of the interior panels.

The final paper was presented by Dr Raf Orlowski of Cambridge University who discussed the use of physical scale models for investigating sound fields in factories. Dr Orlowski showed that an actual working factory can be modelled with reasonable accuracy at a scale factor of 1:16. The factory model is now being used to study the effect of various noise control measures; an example was given showing the results of using suspended absorbers.

Surprisingly, these absorbers can, in certain cases, increase noise levels at low frequencies owing to the back-scattering of sound energy towards the noise source.

The discussion period lasted over an hour and was ably conducted by the Chairman Dr Frank (Robin Day) Fahy. The main points that emerged from the discussion are:

1 The HSE is maintaining a vigorous policy in ensuring that workers are not exposed to excessive noise levels. The criteria of the HSE are based on quantitative measures although, in addition to these quantitative criteria, it was generally agreed that significant subjective benefits occur when factory spaces are treated with absorbent material. Many felt that it would be useful to investigate these subjective benefits and attempt to quantify them although the task is not straightforward.

2 There was unanimous agreement that the classical reverberation theories, namely Sabine's and Eyring's,

are generally not applicable to the acoustics of factory spaces. The Chairman concluded on this point by stating that it is now necessary to remove these theories from textbooks where they refer to factory spaces and replace them with current theories.

3 The new theories developed by Dr Jovicic and Dr Lindqvist appear to be the most suitable for describing the acoustics of factory spaces. However, there are still difficulties with their practical application, in particular with ascribing accurate values to the parameters in the theories. Further work remains to be done in resolving this by making measurements in more factories in combination with tests at model scale.

In conclusion, this was a very useful meeting where delegates from the HSE, consulting firms and universities were able to share their experiences and gain an overview of the various approaches to noise control in factory buildings. □

Rafal Orlowski

Appreciations

Harvey Fletcher

The passing of Harvey Fletcher on 23 July 1981 was another severance with the developing era of acoustics of the 1930s. He was born in Provo, Utah, in September 1884 and after receiving his BS degree from Brigham Young University in 1907 he commenced graduate studies in the following year at the University of Chicago. It was here that he worked with the celebrated Professor R A Millikan on the famous oil-drop experiment which led to the precise measurement of the charge of an electron. Fletcher received his PhD in physics from the University in 1911 with the distinction Summa cum Laude. In the autumn of that year he returned to Brigham Young University as Chairman of the Physics Department. The Western Electric after a number of attempts succeeded in persuading Harvey to join them. His decision was largely prompted by the President of the Mormon Church to which he had a life-long attachment and in which he held a number of prestigious positions.

It was his work at Western Electric that led Fletcher into acoustics and he

was instrumental in the early development of hearing aids and audiometers. The classical Fletcher-Munson equal loudness contour chart holds a unique position in the study of human hearing. Fletcher became Director of Physical Research at Western Electric and continued as such when the Bell Telephone Laboratories were organised in 1925.

To the majority of present-day acousticians the name of Fletcher will be immediately associated with his outstanding work entitled *Speech and Hearing* and few will know that he was the first-elected President of the Acoustical Society of America when it was formed in 1929. It must have afforded him considerable pleasure to have been able to attend the Fiftieth Anniversary Celebrations of the Society at Boston in 1979.

RWBS

John C Johnson (1921-1982)

Acoustics at Pennsylvania State University has suffered a second misfortune with the sudden passing of John C Johnson which has followed so closely upon the death of John Snowdon. John Johnson received his MA and PhD from the University of

Michigan and after a period in industry returned to the University as Head of the Acoustics Laboratory. It was at Penn State, to which he was appointed in 1959 as Head of the Ordnance Research Laboratory (now known as The Applied Research Laboratory), that Johnson's full potential was realised. Under his guidance both basic acoustics, particularly in noise and underwater sound, and applied acoustics related mostly to underwater devices, were most successfully pursued. In fact the award of a University Professorship to Johnson was a token of the esteem that his Applied Research Laboratory had acquired. Additionally he devoted a great deal of effort to education in acoustics and a degree course in acoustics was inaugurated by him at Penn State in the mid-1960s. His enthusiasm for his subject was infectious and I was most impressed by this quality at a FASE meeting on Acoustic Education at which he presided. John Johnson will also be greatly missed for his long continuing services to professional societies. It is particularly sad to think that his recent relinquishment of the headship of his institute to enable him to engage more actively in research was destined to remain unfulfilled. □

RWBS

BRANCH AND GROUP NEWS

North East Branch

The first meeting of 1982 took the form of an industrial visit in January to the Bestobell Acoustics factory, Cramlington. Here, Alan Franks, the Company's project engineer, showed a small group of members around the compact site which produces noise control kits for the cabs of large agricultural and construction vehicles; the visit was most interesting and worthwhile.

The end of February again brought the time for the AGM and Bar Sports; the weather was kind and for the second year running there was no snow to interfere with travel arrangements. After an invigorating meeting, the members adjourned to the Staff Association Bar where modern computer aids to acoustics joined the more conventional Bar Sports in speeding the evening by.

Owing to an administrative oversight, the acceptance of the new Constitution could not be discussed at the AGM. An extraordinary general meeting was therefore held in March especially for this purpose; the new Constitution was duly accepted and comes into full operation at the next AGM.

Also in March the Branch held a one-day meeting on *Flow Induced Noise and Vibration* at the Museum of Science and Technology, Newcastle; this popular topic, at an excellent venue, attracted 25 delegates to hear the five speakers present their varied and interesting papers on the subject. Brian Erskine (ICI) opened the proceedings with a review paper which culminated in an ear-splitting demonstration of Rijke's tube. Following speakers dealt with the controlled investigations of unstable vibrations in tube bundles and the interaction between acoustic modes and vibrational properties of tubes in a rectangular duct. The last two speakers dealt with practical aspects of reducing the phenomenon and with measuring vibrations in extremely adverse environments. The meeting finished off with a general discussion of the day's proceedings and associated topics.

At the end of April, Mike Ankers (City of Manchester Environmental Health Department) addressed a meeting at Darlington Town Hall. His *Thoughts on Current Noise Laws and*

Practice was intended to provoke discussion and comment and on both counts it succeeded. The large audience of members and visiting EHOs fully entered into the spirit of the meeting and its success was fully reflected in the level of discussion at the end.

Early in the merrie month of May the venue switched again, to Carlisle Civic Centre. Here John Bickerdike (Leeds Polytechnic) gave his *Code of Practice for Discotheque Noise* to an audience attracted mainly from Cumbria and Southern Scotland. His presentation explained how and why each section of the proposed code was written, providing a valuable insight into the document when it is issued eventually.

The 1981/82 session of meetings concluded at what must surely be the highest venue yet for any Institute meeting. On the evening of 20 May, about 20 members and friends were the guests of the Durham Cathedral Guild of Bellringers at one of their practice sessions. The venue was the bell-ringing room in the main tower of the Cathedral—165 feet or more above ground level. Here, after tramping up about 200 steps, Malcolm Johnson, the Bell Major, described how the original eight bells were removed and rehung together with two new bells in 1980/81. He then proceeded to demonstrate (with the aid of his team) the art of bell ringing on a grand scale, giving an excellent demonstration of the many variations to be rung on the bells in his charge. Towards the end of the visit we ascended another 20 feet or so into the bell loft to see and hear the bells at closer range whilst two of the bells were rung into the 'down' position. After the visit the party retired to a local hotel where a thoroughly interesting and enjoyable evening came to a pleasant conclusion.

Organisation of the 1982/83 session of meetings has already started; as always the aim is to provide something of interest for every member of the Branch at some time during the programme. On that basis, the session just finished was a huge success. □

T Smith

North West Branch

In April about 20 members of the NW Branch visited Pilkington Flat Glass Ltd at St Helens, where they were

shown the float process which has revolutionised flat glass production. Molten glass is continuously floated over a bath of molten tin and, under carefully controlled temperature and atmosphere, is gradually cooled until it solidifies. It is then cut and stored. The line has a design life of five years and operates continuously for that period, the process being characterised by high levels of automation and quality of product.

After the tour, members were given a presentation on the acoustics of glass and glazing by Cliff Inman (Fellow), of Pilkington's Environmental Advisory Service, followed by a more practical (and in more than one case, shattering) demonstration of other physical qualities of the material in toughened, laminated and wired form. The afternoon concluded with light refreshments provided by the company, who had also specially extended the opening hours of the Glass Museum for the convenience of members. Pilkington Ltd and staff were warmly thanked by the Chairman for the instructive and entertaining proceedings. A visit to the museum is much recommended; entrance is free and it is open most days (details St Helens (0744) 28882).

Southern Branch

The Southern Branch programme for 1981/82 is drawing to a close and its efforts have to be viewed with mixed feelings. A varied programme was arranged mainly based on evening meetings at approximately monthly intervals.

David Harman of Canberra, Australia, gave an interesting personal review of the varied noise legislation between the different States in Australia, putting into context of the local environment what would appear to be a bewildering pattern of legislation. This talk was followed by an audio-visual tour of some auditoria in Australia and New Zealand given by James Powell of Portsmouth Polytechnic. The forum *DIY Acoustics for Everyman* held at Southampton in 1981 and attracting over a hundred people was repeated at Portsmouth in November but attracted four people, which may have been due to a public meeting held on the same evening. This was a shame because the panel consisting of an Environmental Health Officer, an Acoustic Consultant and an acoustician/Hi-Fi enthusiast produced an excellent and polished presentation that had provoked a great deal of

interest and lively discussion from the audience in Southampton. The lecture to the AGM in December was given by Alan Bush of Southampton Environmental Health Department who pointed out some of the anomalies that can occur within noise insulation regulations and traffic noise. Few people were interested in the Social Evening in January but those who turned out had a very enjoyable evening out at Colleys Restaurant in Southampton.

James Powell organised a one-day meeting at Portsmouth on behalf of Southern Branch titled *Design and the Consultant* in which architects, designers and consultants were invited to present joint papers highlighting acoustic problems, solutions and construction details. This was a most successful meeting with two interesting papers presented by Denis Paolletti of San Francisco as well as papers from local architects and consultants.

Dr Robert Weir of Acoustic Technology Ltd talked on *Vibration Measurements in Machinery Monitoring* in March, illustrating this with examples of machine failure. A visit to TV South has had to be cancelled because of the changeover of the franchise from Southern Television but this has been replaced by a well supported visit to Westland Helicopters in June. It is unlikely that the members will be given free samples but we live in hope. This visit is made jointly with the newly formed South Western Branch.

Attendances at meetings have on the whole had better support at Southampton than at Portsmouth and are generally attended by 15-20 people, but our main concern is that in general this support has been to a large extent outside the Branch membership.

The Branch numbers currently about 90 people who directly express affiliation to the area and the distribution ranges from Birmingham to Cambridge, London and the Home Counties, Hants, Sussex and Dorset. This undoubtedly prevents members from attending most of the evening meetings based in Southampton and in Portsmouth. The direct financial and implied support given by these members is much appreciated; without it we would have ceased to exist and the committee is seeking ways in which a greater proportion of members could participate.

The main business at the AGM held in December 1981, in addition to receiv-

ing the reports of Chairman, Secretary and Treasurer, was also to elect a Chairman and Committee. Dr James Powell did not wish to seek re-election as Chairman. The Committee felt that they were unable to nominate anyone despite much canvassing of various parties. It felt that a nomination should be sought from outside the committee in order to revitalise Southern Branch and bring in fresh ideas to improve support from members. No such nomination could be found from the AGM. The committee was instructed to pursue the task of finding a Chairman, with a resolution passed that if no nomination could be found an EGM should be called by the end of June to discuss the future of Southern Branch.

An EGM was held on 12 May which was sparsely attended, but Ian

Sharland of Winchester was nominated and elected as Chairman. The meeting also discussed the future of Southern Branch and decided that it should continue. It is hoped that a shift to half-day meetings with, say, two or three speakers might prove more acceptable to members, and the Honorary Secretary would welcome comments on this as well as suggestions for meeting topics, speakers and locations as soon as possible.

The introduction of new Branches as proposed by Council will make a big difference to the distribution of Branch members and it should generate more interest in a smaller catchment area; however it can succeed only by the efforts and interest of the members. □

R Shack

London Evening Meetings

The London Evening Meeting on 29 April 1982 was addressed by Bill Gracey, with a talk on *Latest Instrumentation for Environmental and Building Acoustic Surveys*. Mr Gracey had brought the latest sound measurement system from Norwegian Electronics, the Type 823, to demonstrate to the meeting.

The first analysers of this type, for building acoustics only, were mainly twin channel measuring systems and a noise generator. The new machine is designed to do much more than this, and one box can be used for a multitude of measurements and analyses.

Mr Gracey demonstrated the numerous operations of the Type 823 to an increasingly amazed audience until finally the machine closed the meeting, and took us all over to the pub for a drink.

Sue Bird

Talk 8 of this sixth session of LEMs, held on 27 May, was given by Dr T J Hickman of Wimpey Laboratories on the subject of *Vibration from Piling Operations*. A talk along similar lines by Dr Hickman's colleague Dr Langley

was disrupted earlier in the year by British Rail industrial action and the theme was thought worthy of repeating.

The talk started with an introduction to the methods used for the measurement and analysis of vibration monitoring and went on to discuss many interesting case histories, each of which provoked lively discussion from the floor. The speaker mentioned one particularly disturbing case where concern was expressed that vibration may have been affecting beer stored in the cellar of a public house adjacent to a pile driving site. This revelation inevitably led to continuation of the discussion in the Jubilee Tavern, where after careful sampling it was concluded that their beer had certainly not been affected.

Paul Freeborn

Readers interested in monthly beer sampling — or even in acoustics — should consult the next (October) Bulletin for the '82/'83 programme of LEMs. Any suggestions for topics of interest please to Peter Smith (01-894 5143) or to Rob Hill (Hemel Hempstead 47146). □

IOA Diploma Prize 1981

Diploma Project Report by J M Southwell (continued from April issue)

Observations and Conclusions

Noise Advisory Council Prediction Method

Using the most accurate information available, that derived by observation, in the prediction formulae it was determined that in 95 per cent of predictions the L_{eq} value would fall within ± 2.0 dB of the actual L_{eq} value. This indicates that this particular prediction method is adequate for the task for which it was designed and comparable with the prediction methods for other types of transportation noise. However, as with all prediction methods, its accuracy is dependent upon the data available for those variables that influence the prediction formulae. At present there is insufficient data to cover all situations, but that which is available appears to be sufficiently accurate to enable 95 per cent of predicted results to fall within approximately ± 3.5 dB of the actual L_{eq} value using this method. As will be seen in the following section there appear to be deficiencies in the accuracy of the available data, especially at other distances than the base distance of twenty-five metres, but the NAC method provides for an equalisation of the under and over estimates of noise levels.

Prediction Method of May

This method when using observed data has confidence limits of ± 2.5 dB for 95 per cent of predicted results. This is nearly as accurate as the NAC method, and would provide an acceptable alternative for predicting rail noise. Unfortunately with the available British Rail data this accuracy is not maintained. The comparable limits are ± 4.0 dB about a mean value which was 2.4 dB lower than the actual L_{eq} values for results at 25 metres from the track. At 50 metres the mean value is approximately 5.0 dB below the actual value.

The under-estimate of the L_{eq} value, which increases with distance from the track, is limited with the British Rail data on wheel/rail noise and their correction values, and the fact that the L_A value is not truly reflected in the maximum wheel/rail noise alone. My observations would indicate that the

wheel/rail maximum noise levels are under-estimated by British Rail, and this error is increased as the distance from the track increases. Also I believe that in general the wheel/rail maximum noise level does not reflect the mean maximum noise level for a train pass-by and some empirical correction is required to take account of locomotive noise.

Correction Methods for Cuttings

Practical difficulties were experienced in gaining data at location B. For this reason the number of samples was small, and as such no real conclusions can be drawn from the results save that a measured maximum noise level gives an accurate prediction of L_{eq} . The correction methods are complex to use, but that of Manning and Kurzweil¹¹ appears to be most promising.

General Conclusions

a When using measured L_A and LAMAX values for a particular location with either observed or British Rail data for the other variables, then either prediction method will provide results within tolerable limits.

b When reliance is placed upon British Rail data for all variables then

the Noise Advisory Council method should be used.

c Further evaluation is required for correction methods and values when propagation is not over level unobstructed ground.

References

- 1 *Noise: The Final Report of the Committee on Noise*. Chairman Alan Wilson.
- 2 *Railway Noise and the Environment — A summary*. 2nd Edition. British Railways Board, 1977.
- 3 *A Guide to Measurement and Prediction of the Equivalent Continuous Sound Level, L_{eq}* . Noise Advisory Council, 1978.
- 4 *Simple prediction equations for wayside Noise*. D N May, *Journal of Sound and Vibration*, 1976, **43**, 572-574.
- 5 *Acoustic and Sociological Survey to Define a Scale of Annoyance Felt by People in their Home due to the Noise of Railroad Trains*. D Aubrée, C S T B. Nantes, 1973.
- 6 *Effect of High Speed Train Noise on the Community along a Railway*. T Sone *et al* *Journal of the Acoustical Society of Japan* **29**, 214-224.
- 7 I S V R Technical Report No 102.
- 8 *Criteria and Limits for Wayside Noise from Trains*. D N May, *Journal of Sound and Vibration*, 1976, **46** (4), 537-550.
- 9 *Noise Units*. Noise Advisory Council.
- 10 *Calculation of Road Traffic Noise*. D O E 1975.
- 11 *Prediction of Wayside Noise from Rail Transit Vehicles*. J E Manning and L G Kurzweil, *Inter Noise 1974*, Washington USA.

Diploma Examination 1982

The examination was held this year on Monday 7 June for the General Module and Tuesday 8 June for the Specialist Modules. The total number of registrants was 155 of which 127 took the General Module. Entries were received for the first time from North Staffordshire Technical College at Stoke-on-Trent. With future possibilities in mind an experiment was tried in March of this year to test the usefulness of Tele-Conferences, in this case with reference to the Diploma Courses. The arrangements were made by Michael Latham, the course tutor at Cornwall Technical College, and the student participants were drawn from a wide area covering such places as Truro, Kidderminster, Swansea, etc. The half-hour session was organised by Latham to cover a number of topics relating to the Diploma so that the questions directed to myself were mostly confined to these topics. I think everybody agreed it was a worthwhile experiment and cost-wise it was only a fraction of that which would have been incurred in travel by the participants. □

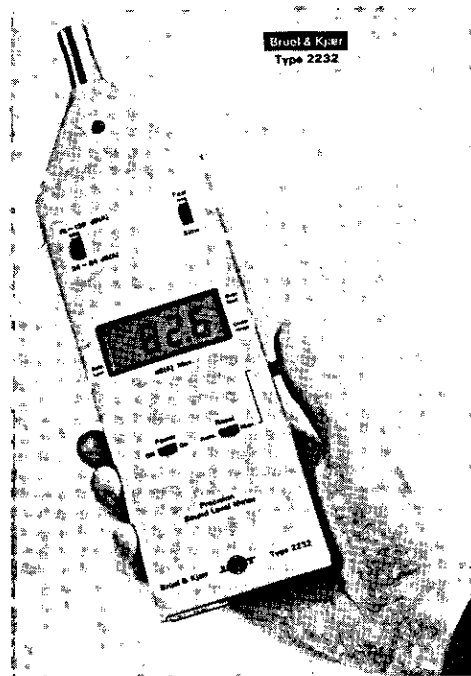
RWBS

New Products

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

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The course this year will be marked by the publication of a book on Advanced Noise and Vibration which comprises the background to the majority of the subjects presented at the course. Contributions are written by members of, or others closely associated with, ISVR. The book is to be published by Ellis Horwood Ltd of Chichester.

Further details of this and of other ISVR Courses may be obtained from the ISVR Conference Secretary or Dr J G Walker, ISVR Short Course Organiser, The University, Southampton SO9 5NH. Tel: (0703) 559122 exts 2310/752.

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Institute of Acoustics Meetings

1982

28 June	M	Design and Use of Acoustic Test Rooms	Birkbeck College, London
8 - 10 September	M	Auditorium Acoustics	Edinburgh
24 September	BSA	The Practical Applications of Micro-processors in Audiology	London
October	HPA	Transducer Workshop	London
21 October	IOP	Modelling for Impulsive Loads	London
8 - 9 November	M	Autumn Meeting Sessions on: Speech; Subjective Effects of Noise and Vibration; Measurement of Acoustic Power and Intensity; Tyndall Medal Lecture	Bournemouth

1983

February/March	M(P)	Recreational Noise	London
February/March	M(P)	Specification and Measurement of Sound Insulation	London
April	M	Spring Conference — Acoustics '83 (Details to be announced)	
13 - 15 July	M	Inter-Noise 83	Edinburgh

The Institute believes that one of the most important services offered to Members is the provision of a wide range of conferences. The Meetings Committee will be pleased to receive suggestions for conference topics as well as to have comments on the present Meetings Programme. Please send your views via the Secretariat in Edinburgh.

Key

M = Meetings Committee Programme

(P) = Provisional

HPA = Jointly with Hospital Physicists Association

BSA = Jointly with British Society of Audiology

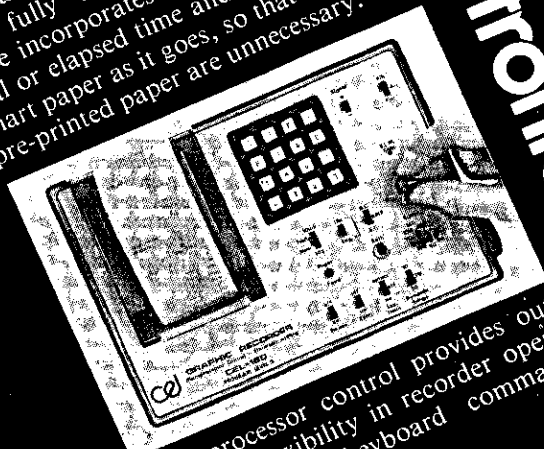
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