

# Acoustics Bulletin

July 1980 Volume 5 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:

## **Acoustical Standards**

National Physical Laboratory, 8 October, 1980

Meeting Organiser: Dr M E Delany FIOA,  
Acoustics Unit, National Physical Laboratory, Teddington, Middlesex  
(200 word abstracts as soon as possible)

## **Autumn Conference 1980**

Hydro Hotel, Windermere, 2-4 November 1980

Conference Organiser: Dr R Lawrence FIOA,  
Acoustics Group, Liverpool Polytechnic, Byrom Street,  
Liverpool L3 3AF

Contributions are invited on any aspect of acoustics particularly  
Environmental Noise; Aerodynamic Noise; Impulse Methods in  
Acoustics  
(200 word abstracts as soon as possible)

## **Acoustic Pattern Recognition**

(Joint with the British Pattern Recognition Society)

University of Surrey, 15 December 1980

Meeting Organiser: Dr J Bowsher FIOA,  
Physics Department, University of Surrey, Guildford, Surrey  
(200 word abstracts as soon as possible)

## **Transducers for Sonar Applications**

University of Birmingham, 16-17 December, 1980

Conference Organiser: Dr B V Smith,  
Department of Electronic and Electrical Engineering, University of  
Birmingham, PO Box 363, Birmingham B15 2TT  
(200 word abstracts as soon as possible)

## **Elastic Waves and Microstructure**

(Joint with the Metals Society, Materials and Testing Group of the  
Institute of Physics and British Institute of Non-Destructive Testing)

Hertford College, Oxford, 16-17 December 1980

(300 word abstracts as soon as possible to

Dr R W B Stephens FIOA,  
Chelsea College, Pulton Place, London SW6 5PR)

## **Active Control of Noise and Vibration**

University of Essex, 19-20 February, 1981

Conference Organiser: Professor G B B Chaplin,  
Department of Electrical Engineering, University of Essex,  
Wivenhoe Park, Colchester CO4 3SQ  
(200 word abstracts by 30 September)

## **Birthday Honours**

**Dr William Allen**, LID, BArch, RIBA,  
HonAssNZIA, HonFIOA

William Allen, past President of the  
IOA, received a CBE in the Queen's  
Birthday Honours.

Bill Allen emigrated to the UK after  
graduating in Canada in the 1930s. He  
held the post of Deputy Head of  
Physics at the Government's Building  
Research Station for eight years and  
then Chief Architect for another eight  
years until 1961, when he joined John  
Bickerdike in setting up his present  
practice, Bickerdike Allen Partners.

Dr Allen is currently chairman of the  
Government's Fire Research Advisory  
Committee and is retained as adviser  
to the US National Bureau of Stand-  
ards on building research. □



## **NEW ELECTIONS**

At its meeting on 24 April 1980,  
Council approved the following elec-  
tions.

### **Fellow**

M J Fisher

### **Member**

|             |                |
|-------------|----------------|
| J Evans     | B E Richardson |
| P A Nelson  | B J Robinson   |
| G B Phelps  | M S Sugiura    |
| T L Redmore |                |

### **Associate**

|            |              |
|------------|--------------|
| A C Conrad | W H Olsen    |
| S Dracup   | P R Phillips |
| Y K Leow   |              |



**Editor:**  
F A Hill

**Associate Editors:**  
S J Flockton J W Sargent  
A J Pretlove R W B Stephens

**Advertising enquiries to:**  
H A Collins Ltd  
37 Ruskin Road  
Carshalton  
Surrey SM5 3BQ  
Telephone: 01-647 1393

**Contributions and letters to:**  
Editor, IOA Bulletin  
25 Elm Drive  
St Albans  
Herts AL4 0EJ

**Books for review to:**  
S J Flockton  
Physics Department  
Chelsea College  
Pulton Place  
London SW6

**Published by:**  
The Institute of Acoustics  
25 Chambers Street  
Edinburgh EH1 1HU  
Telephone: 031 225 2143

The views expressed in *Acoustics Bulletin* are not necessarily the official view of the Institute, nor do individual contributions reflect the opinions of the Editor.

Single copy £2.00

Annual subscription (4 issues) £7.50

ISSN: 0308-437X

Multiple copying of the contents or parts thereof without permission is in breach of copyright. Permission is usually given upon written application to the Institute to copy illustrations or short extracts from the text of individual contributions, provided that the source (and where appropriate the copyright) are acknowledged.

© 1980 The Institute of Acoustics

All rights reserved

July 1980

Volume 5

Number 3

## Contents

|                                                                             | page               |
|-----------------------------------------------------------------------------|--------------------|
| Birthday Honours                                                            | inside front cover |
| Calls for Papers                                                            | inside front cover |
| President's Letter                                                          | 3                  |
| Regional Branches and Specialist Groups — IOA Policy                        | 4                  |
| Fees for Retired Members                                                    | 4                  |
| Institute of Acoustics Council 1980-81                                      | 4                  |
| Non-Institute Meetings                                                      | 4                  |
| Spring Conference & Exhibition — Acoustics 80                               | 5                  |
| Sound Systems and Auditorium Acoustics                                      | 9                  |
| Musical Instrument Acoustics                                                | 10                 |
| People Noise and Buildings                                                  | 11                 |
| Elastic Wave Propagation and Scattering in Seismology and Materials Testing | 12                 |
| Foreign Journals                                                            | 13                 |
| Annual Report of the Council 1979                                           | 14                 |
| Honorary Fellows of the Institute of Acoustics                              | 18                 |
| Abstracts: Low Noise Automotive Diesel Engines                              | 19                 |
| Noise Control in Hospital Buildings                                         | 20                 |
| The Honorary Officers of the Institute of Acoustics                         | 23                 |
| Rayleigh Medal 1980                                                         | 25                 |
| Acousto-Optics and its Applications                                         | 26                 |
| Report of the Auditors and Accounts                                         | 27                 |
| Treasurer's Report                                                          | 30                 |
| Noise Control and the Environmental Health Officer                          | 31                 |
| Traffic Noise in Perspective                                                | 33                 |
| International INCE                                                          | 35                 |
| Branch and Group News                                                       | 37                 |
| Diploma in Acoustics and Noise Control                                      | 37                 |
| London Evening Meetings                                                     | 38                 |
| New Products                                                                | 39                 |
| Book Reviews                                                                | 40                 |
| Institute of Acoustics 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.

## Noise and Vibration Engineers (Underwater Weapons)

Our Underwater Weapons Division requires Noise and Vibration Engineers on large new contracts for underwater weapons.

Many aspects of noise control are involved including machinery noise, flow noise and rotor noise. Previous experience in underwater acoustics is desirable but not essential. A knowledge of fluid dynamics is required for some posts.

Salaries are negotiable up to £9000 for senior appointments.

These posts are in a small group providing specialised expertise in the propulsion and control field for the new British Stingray Torpedo and for other advanced underwater guided missiles.

Application forms and further information can be obtained from:

**David Hammersley or Tony Ormonde-Dobbin,  
Marconi Space and Defence Systems Ltd,  
Underwater Weapons Division,  
The Airport,  
Portsmouth,  
Hants.  
Telephone Portsmouth (0705) 697913.**

Polytechnic of the South Bank

## M. Sc. Environmental Acoustics

(Part time)

This two year course is broad based, but emphasises the Acoustics of the Internal Environment and will be particularly useful to those concerned with Environmental Engineering.

The course commences in January 1981, attendance one day and evening per week, and covers Subjective Acoustics, Acoustic Theory, Acoustic Measurement, Engineering Acoustics, Mathematics and laboratory work; a mutually agreed project will be undertaken in the second year.

A preliminary course in Acoustics and Mathematics, for those who require it, begins this October.

Further details from:

**Dr John Roberts (Ref IE1), I.E.S.T., Polytechnic of the South Bank, Borough Road, London SE1 0AA. Tel: 01-928 8989 Ext. 2122/2101.**

# Environmental Specialists

in: Noise and Vibration      Air Pollution  
Solid and Toxic Waste Management

**Hong Kong**

**£10,850 p.a.**

- 25% gratuity on salary
- Low tax area
- Medical/dental benefits
- Free passages

- Generous terminal leave
- Subsidised accommodation
- Education allowances
- Holiday visits for children

Applications are invited from specialists in noise and vibration, air pollution and waste management for appointment as Senior Environmental Protection Officers to head Sections in the Environmental Protection Unit of the Hong Kong Government. This is an excellent opportunity to join a newly established Unit and to make a real contribution to environmental protection in this dynamic area. Duties will include the organisation and control of on-going monitoring schemes, establishing present levels and future trends of pollution, conducting field surveys and preparing assessments on specific developments that are likely to have significant adverse environmental impact, formulation of legislation, environmental quality guidelines and emission standards, codes of practice and maintaining liaison with Pollution Control Units in Government Departments.

Applicants should have an Honours degree in a scientific or engineering subject from a British university, or equivalent; and 7 years' relevant post-graduate experience.

\*Based on exchange rate HS11.50 = £1.00. This rate is subject to fluctuation.

Particularly relevant experience would be in such fields as notification and control of toxic and other difficult wastes, land reclamation design waste disposal models, automatic methods of air pollution data capture and analysis, air pollution control including modelling studies, engineering design, noise surveys and control of industrial and transportation noise and vibration and rule making.

Preference will be given to candidates who can speak both Cantonese and English.

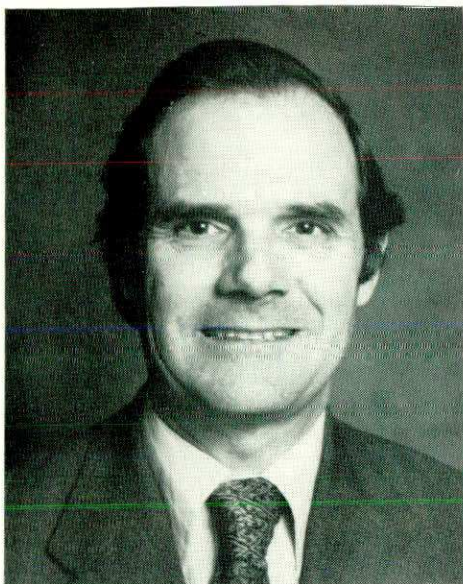
Appointment will be for an initial period of 3 years. The pay scale for the post is \$10,400 to \$11,200 p.m. (approx £10,850 to £11,690 p.a.\*).

For further information and an application form, write to the Hong Kong Government Office, 6 Grafton Street, London, W1X 3LB quoting reference GS/SEPO at the top of your letter. Closing date for return of application forms: 12 August 1980.

**Hong Kong Government**







## President's Letter

### **Institute of Acoustics**

#### **President**

Prof B L Clarkson  
ISVR, Southampton University

#### **Immediate Past President**

Prof P Lord  
Salford University

#### **President-Elect**

Dr D E Weston  
Admiralty Underwater  
Weapons Establishment

#### **Vice-Presidents**

Dr M E Delany  
National Physical Laboratory

Prof D J Johns  
Loughborough University

Dr R Lawrence  
Liverpool Polytechnic

#### **Honorary Treasurer**

Dr H G Leventhall  
Chelsea College, London

#### **Honorary Secretary**

Dr F J Fahy  
ISVR, Southampton University

*Dear Member,*

*I should like to thank you for the great honour that you have given to me in electing me as your President for the next two-year term. In taking over this office I am very conscious of the contributions which my predecessors have made in building up our very young Institute. We have already been through three major phases: the birth pangs, the creation of corporate grades, and most recently the move to complete independence from the Institute of Physics. I wish to acknowledge the support and loyalty of the membership in these changes. In the next two-year period I do not foresee any major crises (I am always an optimist!) and therefore I hope that we can concentrate on strengthening the Institute.*

*I would like to see our activities develop so that the majority of the membership becomes involved in at least one activity per year. Wouldn't it be marvellous if the Spring Meeting could become accepted as the place where all acousticians meet once per year? As a target for my Presidency I should like to see at least half the membership at the Spring Meeting in 1982 when I hand over to David Weston.*

*B. L. Clarkson*



## Regional Branches and Specialist Groups – IOA Policy

Council recently delegated a small sub-group consisting of Professor P Lord (chairman), J Bickerdike, R Harrison and T Smith, to make proposals regarding IOA policy on Regional Branches and Specialist Groups.

The sub-group's terms of reference were:

- (i) to study the constitutions of regional branches and specialist groups and to suggest improvements,
- (ii) to study the policies of other institutions towards regional branches and specialist groups, and
- (iii) to make recommendations regarding IOA policy on regional branches and specialist groups, including organisations and funding.

The sub-group will be reporting back to Council in December 1980.

In compiling their report the sub-group wish to take into account the feeling of all members on these matters; members wishing to comment on any aspect should do so in writing by 31 August.

Branches and Groups have already been contacted directly about these matters. □

## Non-Institute Meetings

### 1980

|                        |                                                                                                                       |                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>9-16 July</b>       | 10th ICA                                                                                                              | Sydney, Australia                   |
| <b>18-19 July</b>      | International Conference and Exhibition of Ultrasonics                                                                | New Delhi, India                    |
| <b>25-27 August</b>    | International Symposium on Effects of Impulse Noise on Hearing (Swedish Work Environment Fund and University of Lund) | Sweden                              |
| <b>9-11 September</b>  | Industry and Environment (Loughborough University of Technology and The Institution of Environmental Sciences)        | Loughborough                        |
| <b>10-12 September</b> | Second International Conference on Ultrasonically Guided Percutaneous Puncture                                        | University of Copenhagen, Denmark   |
| <b>15-19 September</b> | American Institute of Ultrasound in Medicine                                                                          | New Orleans                         |
| <b>16-19 September</b> | Siduo 8, Biannual Congress of the International Society of Ultrasonic Diagnosis in Ophthalmology                      | University of Nijmegen, Netherlands |
| <b>October</b>         | Noise, Buildings and People (South African Acoustics Institute)                                                       | Durban, South Africa                |
| <b>7-11 October</b>    | Man and Machine Noise (11th Congress of International Noise Abatement Association)                                    | Bulgaria                            |
| <b>12-16 October</b>   | 10th International Symposium on Acoustical Imaging                                                                    | Cannes, France                      |
| <b>5-7 November</b>    | IEEE Ultrasonics Symposium                                                                                            | Boston, USA                         |
| <b>18-21 November</b>  | Meeting of the Acoustical Society of America                                                                          | Los Angeles, USA                    |
| <b>December</b>        | British Medical Ultrasound Society AGM                                                                                | Nottingham                          |
| <b>8-10 December</b>   | Inter-Noise 80. 9th International Conference on Noise Control Engineering                                             | Miami, Florida USA                  |
| <b>1981</b>            |                                                                                                                       |                                     |
| <b>6-8 October</b>     | Inter-Noise 81                                                                                                        | Amsterdam                           |

## Fees for Retired Members

Council has recently agreed to modifications in the membership fees and Conference registration charges to members of the Institute who have retired from their full-time occupation and are dependent on their pension. It has been recognised that retired members without earned income are unable to set their membership fees against income tax and that they may, in any case, be in reduced circumstances during their retirement. It has therefore been decided that:

- a) Retired members without earned income are invited to write to the Secretary requesting to be considered for payment of reduced membership fees. These will be at half the current rate for their grade at retirement.
- b) Retired members who pay the reduced membership fee may also attend Institute Conferences at the student rate.

## INSTITUTE OF ACOUSTICS COUNCIL 1980-81

**President** Prof B L Clarkson

**President-Elect**  
Dr D E Weston

**Immediate Past President**  
Prof P Lord

**Hon Secretary**  
Dr F J Fahy

**Hon Treasurer**  
Dr H G Leventhall

**Vice-Presidents**  
Dr M E Delany  
Prof D J Johns  
Dr R Lawrence

**Ordinary Members**  
Mr M S Ankers (co-opted)  
Mr J Bickerdike  
Dr J M Bowsher  
Prof E R Dobbs (co-opted)  
Mr R Harrison  
Dr R W G Haslett  
Mr R C Hill  
Mr J N Holmes  
Dr R K Mackenzie  
Dr T J B Smith  
Mr T Smith  
Mr R M Taylor

**To attend by Open Invitation**  
Dr B J Smith  
Dr R W B Stephens

# SPRING CONFERENCE & EXHIBITION

## ACOUSTICS 80

**T**HE INSTITUTE has held another successful Spring Meeting, this year at Bedford College, in the delightful surroundings of Regent's Park. There were about 140 delegates, the majority of whom sent in their registrations rather late. This caused considerable difficulties to the Office and Organisers as the Institute was required to make final reservations at a time when substantial registrations were still being received. We had to try to guess final numbers and, although we were good guessers in some cases, in others we were not and there was a loss of over £200 on reservations, meals etc which were not taken up. Please, dear delegates, for future Conferences try to put your registration in by the recommended date and so avoid these difficulties.

The Conference itself was generally acknowledged to have been a great success. Accounts of the individual Sessions are given below and in addition there were interesting papers given by Professor Phil Doak on *Theory in Engineering Acoustics* following the presentation to him of the Rayleigh Medal, by Dr V L Jordan on *Auditorium Acoustics — Criteria, Examples, Trends* and by Mr R L Wilson on *Transportation Noise in Perspective*. We were also particularly pleased to welcome Professor Fritz Ingerslev who, as Chairman of International INCE, spoke to us about this organisation which the Institute has recently joined.

As Conference Organiser, my thanks go to the Edinburgh Office which did all the registration. Their task would have been easier if delegates had filled in their registration forms more carefully and sent the correct money. It may be that we are so accustomed to working in decibels that we find it difficult to calculate percentage VAT correctly! Further thanks are due to the Session Organisers and particularly to the Local Organiser, Dr M J Lea of Bedford College Physics Department, who put a great deal of background effort into organising the day to day running of the Conference, the Reception and the Dinner. We are also indebted to Roy Lawrence, who not only saw to the printing of the

Proceedings, but delivered them in person to Bedford College having, with typical assured brinkmanship, delayed printing to the last possible moment so that papers could be included.

H G Leventhall

### DESIGN FOR GOOD SOUND IN BUILDINGS

Meetings on building acoustics are traditionally held in halls with poor acoustics—it spurs us on to higher things! Tuke Hall, with squeaky floors and noisy doors, exacerbated at times by a lawn-mower outside (cf EEC Regulations) and quiet spoken, sometimes overseas accents inside, demanded an attentive audience.

Brian Day chaired the Wednesday morning session which, loosely speaking, dealt with room acoustic techniques. A recurring theme was the inadequacy of RT alone in characterising room acoustics; most authors regarded spatial decay rates and discrete reflections as more interesting and more important subjectively. Usually papers were complemented by good slides which were very helpful, but unfortunately Parkin and Yousif's new electro-acoustic reflector (EAR) remained somewhat mysterious. All the papers dealt with the early stages of projects and we eagerly await future developments; consultants in the audience must have been envious of the facilities described—let's hope these bear fruit. Unfortunately there was little time for discussion.

Thursday morning was devoted largely to Multipurpose Halls and chaired with characteristic good humour by Jeff Charles (many a true word is spoken in jest). Again good slides brought the papers to life and for the uninitiated this was particularly true of Michael Holden's historical review of theatre and multipurpose halls. Mike Barron eloquently defended the benefits of diffusion and the classical RT calculation while Alex Burd demonstrated the common experience that it is difficult to get this calculation right in a real auditorium. Chris Gifford got it right! On the other hand he admitted to solving a tricky aircraft noise sound insulation problem flying

more or less by the seat of his pants and defying gravity (the mass law)!

Richard Cowell described the acoustic design and initial user reaction of the Hexagon, a visit to which was planned during the afternoon and evening; the morning ended with a review by the invited lecturer Dr V L Jordan, prefaced by mention of his new book (reviewed elsewhere in this Bulletin) and illustrated by his experiences as consultant for many of the world's major auditoria.

Among the many interesting points arising from these papers was the confusing diversity of RT/frequency characteristics, both recommended and achieved, for ostensibly similar musical purposes. The extremes were represented by a flat frequency characteristic with a small reduction at low and small rise at high frequencies, compared with a flat characteristic rising by as much as 50% at low frequencies.

In the afternoon a small party visited the Reading Hexagon where Richard Cowell showed us round and exemplified the points made in his morning lecture. Unfortunately the majority of the morning's authors were not present, but a lively discussion on Assisted Resonance followed a demonstration of the Hexagon system set up by Peter Barnett, questionably assisted by an *ad hoc* vocal quartet. Predictably a wide range of opinions on AR were voiced, but it was clear that the general understanding of the principles and practice of assisted resonance systems is poor. Does anyone know how it works?

The party returned to the Hexagon in the evening for a performance of Noel Coward's *Present Laughter* in which the general excellence of the hall for speech was evident. This was an enjoyable and instructive visit, though unfortunately it was under-subscribed and made a loss. The organisers would be greatly helped if people registered in good time.

On Friday morning the lion's share of papers on sound transmission went to Heriot Watt University in the final session chaired by Les Fothergill. With



only four papers there was ample time for discussion. This was lively and centred on SEA and sound insulation modelling. Heriot Watt clearly hope to make further advances in these areas.

In conclusion, my overall impression of the sessions on Design for Good Sound in Buildings was that, besides the formal papers on recent advances, there is a need for basic education among acousticians, including this reporter!

Topics in the latter category might include modelling techniques (structural and acoustic), SEA, assisted resonance and impulse techniques, in all of which fairly well established theory and techniques are not widely understood and used, but could in some instances be borrowed from other engineering disciplines.

D B Fleming

## ACOUSTICS IN CONDITION DIAGNOSIS

When the condition of a machine or any operating unit can be determined reliably whilst in operation, a decision may be made to shut it down before or after the deadline specified by the more traditional planned maintenance concept—resulting in considerable savings, increased efficiency and safer operation.

In view of the complexity of present day machines and plants, the science of condition monitoring and fault diagnosis is gaining enhanced prominence. In this context noise and vibration response measurements have been shown to give reliable and accurate information on the condition of operating machines: hence the inclusion of special sessions on *Acoustics in Condition Diagnosis* during the Spring Conference.

Twenty papers were accepted and presented during the conference: six papers dealing with specifically developed instrumentation and analysis equipment for condition diagnosis; 11 papers on various applications and approaches to the use of acoustics in condition monitoring; and 3 papers on the relatively new approach to the use of acoustic response to diagnose certain abnormal conditions and diseases in man.

The opening paper was given by Dr Ralph Collacott (UK Mechanical Health Monitoring Group), who pointed out the present urgency to establish more representative criteria for vibration monitoring of machines.

Darryl Coffey of Computer Engineering Ltd in his paper on *Piezoelectric Transducers for Use in Knock Detection* presented an account of their latest ring transducers which can replace the spark plug washer and provide a measure of knock severity in SI engines. Apparently the system is currently being tested for adaptation to diesel applications as well. Tony Myles, again of Computer Engineering Ltd, provided a survey of some basic data acquisition for monitoring systems. This was followed by George Sawyer of Vibro-Meter Ltd, on *Non-Invasive Sonic Signature—A Novel Monitoring Technique* which outlined an effective set-up of transducers for monitoring impacts, sliding, rolling, scratching, rubbing, etc. The instrumentation session was concluded by two papers given by G J Hilton of Spectral Dynamics on *Signature Analysis Techniques using Digital Spectrum Analysis and Improvement of Signal to Noise in Frequency Spectrum Measurements* showing the benefit of narrow band noise vibration analysis and three-dimensional plots to observe the development of certain faults at discrete frequencies.

The three papers on *Acoustics in Condition Diagnosis—Man* proved of much interest to an audience largely made of machine diagnosticians! Dr J J Knight of the Institute of Laryngology and Otology of the University of London presented a most absorbing paper on *Acoustics as a diagnostic aid in disease of the ears, nose and throat*. He reported interesting cases of assessing occupational deafness, tinnitus and other applications. Miss M Scott (co-authors C J Lea and G D Cain) of Mount Vernon Hospital followed with a presentation which reported on developing a special gadget that can be fitted to the mouth of patients suffering from chronic obstructive airways disease. The breath sounds can then be analysed to diagnose the severity of the said disease. The final paper in the same theme was given by Ron Walford, formerly of Chelsea College, on *Acoustical Techniques for Diagnosing Low Frequency Tinnitus in Noise Complaints known as Hummers*.

The theme reverted to applications of machine diagnosis when Dr Sam Haddad (session organiser) of the Department of Transport Technology, Loughborough University, presented a paper on *Diagnosis of Abnormal Operation in Diesel Engines using Vibration Oscillographs and Frequency Analysis*, which illustrated the use of simplified

oscillograph records and third octave engine vibration analysis to obtain a reliable measure of diesel engine faults. This was followed by a lively presentation and demonstration from Mr Noel Trigg of Helitune on *On-Site Vibration Measurement, Dynamic Tracking and Balancing* as applied to helicopter monitoring. I have heard Noel a few times at my condition monitoring short courses and other occasions and always enjoyed the enthusiasm he injects into his presentations.

Mr Fred Corben of AMTE, Teddington, gave a paper which dealt with analysis of machinery noise response—but the monitoring side was not made very clear. Ron Stewart of the Machinery Health Monitoring Group of ISVR gave a presentation on *The Strengths and Weaknesses of Vibration Monitoring applied to Gearboxes*. Ron and his group have gathered a wealth of expertise in diagnostics and this presentation gave us an insight into some of the pitfalls in misinterpreting vibration analysis. This presentation was followed by Peter Brunn of SPM Instruments who outlined the ins and outs of *The Shock Pulse Method for Condition Assessment of Rolling Element Bearings*. The paper by Stewart Andrews of British Leyland Cars on *The Noise and Source Identification of Automobile Gearboxes and Final Drives* was included in the proceedings as a written paper only.

Next Mr Pat McNulty of the National Engineering Laboratory East Kilbride, reported on the use of noise and vibration generated in pumps for monitoring cavitation and other machine malfunctions. Mr Tony Herbert (co-author G J Stimpson) of Wolfson Unit ISVR, in his paper on *Noise and Vibration Signature Analysis in Press Noise Reduction*, basically reported on their work to reduce press noise but also showed how these same techniques can equally be used to quantify severities of impacts in presses and similar machines.

Jim Goby of CEGB Dungeness 'B' nuclear power station presented a very interesting paper on *Condition Monitoring Scheme for Dungeness 'B' Nuclear Power Station*. It was practically the only paper that reported the formulation, development and use of a complete condition monitoring system which employs vibration analysis, plant performance, efficiency and special techniques. Also it was refreshing to learn of their progress to date with such an all singing, all dancing system!



Then Professor C Cempel of the Technical University of Poznan, Poland, gave a paper on *Diagnostically Oriented Measures of The Vibro-Acoustical Processes* where he showed the importance of developing special amplitude and spectral process discriminants to produce a reliable vibration diagnostic method. He reported that this method has successfully been used

and diagnosis equipment, which was well received by the delegates.

On the last day of the conference, to conclude these diagnostic sessions it was also possible to conduct a visit to Lucas CAV Ltd in Acton, where a small group of delegates having previously expressed interest in this visit were shown round the CAV noise

levels around new coalfield operations which are expected to take place in the vicinity of residential areas in the UK. Values of Peak Linear Level and C-weighted Sound Exposure Level have been evaluated and shown to give little variation with the depth of the shaft being sunk.

A paper on passenger ride comfort in



*Prof Ingerslev (left) welcomed the IOA as members of I/INCE, of which he is President. Dr Jordan (right) spoke on Auditorium Acoustics*



*Prof Lord presented the Rayleigh Medal to Prof Doak (above) and later delivered his Presidential Address (left). At the Annual Dinner he handed over the President's Medal (right) to his successor — let us hope Prof Clarkson is still feeling as cheerful about being President at the next Spring Conference!*



for detecting bearing failure and car exhaust malfunctions.

Last but by no means least, J L Wearing of Sheffield University (co-author G McNulty) presented a paper on *Vibration Monitoring of Panels for Acoustic Radiation Calculations*.

In spite of the short periods allocated to the paper presentation it was also possible in some cases to have some limited time for discussion which proved very useful.

In addition to the above twenty papers, during the three days' conference a number of companies participated in exhibiting their condition monitoring

research activities and received a most appreciated hospitality; thanks go to Mr A Herbert and Mr M Russell of Lucas CAV for making this visit possible and very worthwhile.

S D Haddad

#### OPEN SESSION

Six papers of diversity fitting the title of the session were presented.

A contribution by Mr G Kerry and Mr Higgins of the University of Salford was presented by Mr Kerry and concerned an analysis of noise levels produced by blasting operations. The work was aimed at improving the accuracy of the prediction of noise

rail vehicles was presented by Dr J L Wearing of the Department of Mechanical Engineering at the University of Sheffield on behalf of two co-workers. A simple mathematical model of an isolated rail vehicle was discussed and the predicted response of such a model to simple rail perturbations was presented. Predicted data were compared with ride index factors for assessing likely subjective reaction.

Dr Wearing also presented a contribution entitled *Substructuring Techniques for the Vibration Analysis of Large Structures*. The method was used to calculate the natural frequency of a cantilevered plate and the result



compared with experimental data and with that of other predictions.

Dr Medvedev of Chuvash University, USSR, and presently working at the Polytechnic of the South Bank, gave a paper on behalf of five workers at this latter establishment. This concerned the results of an increasing study of the sound produced by electrically excited flames. The experimental technique was described and details of recorded sound pressure level were given. Models for explaining the mechanism were discussed.

*The Evaluation of Loudness Equivalent Meters* was the title of a contribution given by Mr B Plumb of Sheffield City Polytechnic. The Exchange Rate Tolerance test of the new draft Health and Safety Executive standard for  $L_{eq}$  meters was applied, using a range of input signal mark:space ratio to five examples of  $L_{eq}$  meter. The disparity among instruments was considerable, tending to emphasise the need for the draft standard.

The final paper was given by Dr K Attenborough of the Open University and was entitled *Point to Point Propagation Over a Porous Half-Space*. This was concerned with a simplified treatment of a theoretical approach to sound propagation over an absorbing plane.

Discussion following each of the above papers was understandably limited, reflecting the variable level of interest and experience available throughout the audience at any particular time. Nevertheless, such discussion as there was tended to underline the value of open sessions of this nature in a general meeting.

R Lawrence

## NOISE IN BUILDING SERVICES

This Session only managed to attract six papers, but the high quality of presentation and level of audience participation led to an informative and enjoyable meeting. Under the chairmanship of Roger Tompsett, the first paper was given by Peter Allaway who presented an enlightening and amusing account of the practical problems involved in vibration isolation of mechanical services. He also discussed the use of simple theory to establish the requirements for anti-vibration of whole buildings, and in particular buildings several hundred feet long affected by passing railway traffic, where the response of the building could by no means be considered simple.

Alan Cummings then described work which he has carried out on low frequency noise breakout from rectangular ducts and said that he had managed to confirm that stiffening of duct walls made little difference to the breakout of airborne noise from ducting systems. This is a method of control which is often used in practice, and subsequent discussion revealed that it is rather more effective than his work would have pointed to, as most noise breakout in ventilating systems is caused by turbulence induced vibration, rather than direct acoustic breakout.

Derek Croome had been working for some time on a simple relationship between fan operation parameters and noise level in the receiving room. By measurement of the in-room sound pressure levels of a large number of relatively simple ventilation systems he had managed to derive such a relationship, which he proposed should be used at the initial design stage of a project to give the mechanical services engineer an indication of the sound level produced by his system.

In contrast to this approach, Anees Iqbal described the problems associated with the complexity and high velocities of modern ventilation systems. He described the use of high-speed computers to calculate noise levels from ventilation systems due to both airborne fan noise and regenerated noise systems. A main point of his paper was that, by the use of these fairly inexpensive high-speed techniques, the mechanical services engineer could look at his design to ensure that it was suitably quiet, and to make modifications where necessary.

Akpan Ukpoho gave an interesting account of work on velocity generated noise to date, presenting an overview of both theoretical and practical work. He stressed the lack of availability of test results for individual ducting fittings and described a method which is being developed at Sheffield University for measuring noise generated by such fittings. This consisted essentially of running a fan/ducting system at a constant speed (and consequently air velocity) and then switching the fan off. The decaying airflow and noise fields are measured simultaneously and it is thus possible to obtain the relationship between airflow and generation noise. It was hoped to continue this work using high-speed microprocessors.

Terry Willson's paper looked at the gaps in present day knowledge of

velocity generated noise in ducting fittings and described work carried out by his organisation on the more commonly used duct fittings in the UK. Analysis of these had given mathematical relationships between the various parameters involved and velocity generated noise.

The Session ended with a long and lively discussion period which centred mainly around practical problems in ventilation systems. The general opinion of the meeting was that there was still a great deal of information lacking for the design of ventilation systems and that skill and judgement was required to achieve a system which met the specified criteria, both from the airborne and structure-borne point of view.

T K Willson

## TRANSPORTATION NOISE

Three sessions were held on Transportation Noise. The first session was chaired by J B Ollerhead (Loughborough University) and was concerned with noise from rail and air transport. J D Clegg (Bolton MBC) outlined the design guidance which had been developed in Bolton to minimise the risk of noise annoyance to people who would be living near railways. He also discussed his experience in the application of the design guide in practical situations. J G Walker (ISVR) described some of the results of a comprehensive study which has been carried out over the past four years on reactions to railway noise in residential areas. It was found that the 24-hour  $L_{eq}$  dB(A) noise index appears to be the most practical choice of indices for representing railway noise. Interesting comparisons between noise annoyance from railways and noise annoyance from road and air transport were also made. Unfortunately, the paper by B Hemsworth (British Rail) was not presented, due to illness. The paper is, however, included in the Proceedings. G J M Botham (Metro-Cammell Ltd) examined the problem of noise in underground rapid transit vehicles and described some of the practical noise control methods which could be applied to these vehicles.

In the aircraft noise section J B Ollerhead described the phenomenon of 'distortion tones' which cause aircraft propulsion fans to yield higher noise levels in static tests than in flight. He reported on experiments carried out using flow conditioners which help to reduce the effect. S A Quinn (West Yorkshire MCC) described an investi-



gation carried out to assess the noise nuisance to be expected from runway changes at Leeds-Bradford Airport. The modification of NNI contours due to variation in ground level around the Airport was considered. J Simson (GLC) discussed the noise effects of helicopters in urban situations and possible methods of alleviating noise problems by operational controls.

The second session was chaired by D C Hothersall (Bradford University) and was concerned with road traffic noise. R A Hood (RTM Planning Partnership) examined some of the problems which he had encountered in describing the impact of a proposed road at a public enquiry. The accuracy of objective noise assessments was discussed and the problems of relating these to the subjective response. J Lyon (Greater Manchester Council) compared simultaneously measured values of  $L_{10}$  and  $L_{eq}$  for a wide variety of sites. He concluded that while a suggested relationship between the values of the two indices, ie  $L_{eq} = L_{10} - 3$ , may be a useful rule of thumb for environmental planning purposes it lacks the precision required for the application of legislation. D Gilbert (Imperial College) described several surveys of traffic noise in urban situations where free and non-free flow occurred and presented prediction equations for  $L_{10}$  as a function of the relevant flow and environmental parameters. Gösta Blücher presented the Joint Nordic Computing Model which has recently been developed with the co-operation of all Nordic countries for predicting the  $L_{eq}$  and  $L_{max}$  levels in dB(A) from road traffic. G D Callow (MIRA) was unable to present his paper due to illness, but a copy of the paper is available in the Proceedings. I D Griffiths (University of Surrey) outlined some of the problems in describing and quantifying human sensitivity to road traffic noise. He discussed these problems in the light of a study of seasonal differences in traffic noise annoyance recently carried out.

P T Lewis was chairman of the final session on Transportation noise. The first paper was by R C Hill (AIRO, St Albans) who presented the results of a study of vibration in dwellings caused by road traffic. Reasonable correlation was found between noise and vibration levels at each measurement site, but poor correlation between sites. This means that changes in vibration levels associated with change in external noise level at particular sites can be predicted but not, as yet, absolute levels. J M Mason (The Walker-Beak-

Mason Partnership) discussed the existing acoustic conditions which had been measured within many office complexes in the Greater London area — in particular, the degree of intrusion arising from road and railway noise sources. Mrs H E Head (Lucas — CAV Ltd) described a series of experiments aimed at determining the source of the excess noise which is experienced when diesel engines accelerate after a period of idling. Convincing evidence was presented indicating that the cause of this phenomenon is the cooler state of the engine after idling which affects the temperature of the intake air and the mechanical tolerances. K Attenborough (Open University) described a study carried out in Canada on the attenuation of sound by the forest floor. It was found that a two-layer model of the forest floor produced predictions of normal surface impedance which lay essentially within the scatter of *in situ* measurements.

D C Hothersall

## PHYSICAL ACOUSTICS AND ULTRASOUND

The Physical Acoustics section of the Meeting was notable for its new approach to attract contributions. This

involved inviting various laboratories to make a block presentation of the work in progress and this was quite successful in attracting a much larger response than in previous years. It also gave an opportunity for younger workers to participate more actively. The University laboratories who contributed, with the number of contributions in brackets, were Bedford (two), Bath (two), Surrey (four), Hull (four) and Chelsea (four), with an interesting theoretical paper by Dr A Freedman (late of AUWE, Portland) on '*Overlapping Resonances*' Theory of Acoustic Transmission through an Elastic Plate.

In consequence of this new approach there was not a restrictive central theme through the three sessions involved, but three papers were read on the interaction of ultrasonic waves with liquid crystals and a number on ultrasonic investigations of the physical properties of materials and on new techniques such as use of lasers for generation of various types of ultrasonic waves and the applications of Photoacoustic Spectroscopy. Finally, mention should be made of the fascinating work at Surrey on the existence of Double Sound in Disparate-Mass Gas Mixtures. □

R W B Stephens

## LOST MEMBERS

Three more members with whom the IOA has lost contact are listed below with their last known addresses. If anyone reading this recognises a colleague — or himself — in this list, please contact the Institute's Secretariat in Edinburgh.

Mr L J Warner  
11 Glovers End  
Horsham  
Sussex

Lt-Cdr Syiett  
HMS Berwick  
BFPO Ships  
London

Dr J D Daley  
Dept of Electrical and Electronic  
Engineering  
Loughborough University  
Loughborough  
Leics LE12 6TF

## Sound Systems and Auditorium Acoustics

All IOA members are invited to attend a special meeting organised by the Institute of Sound and Communications Engineers at the Fairfield Halls, Croydon, on Thursday, 11 September 1980 at 2.30 for 3.00 pm.

Speakers will include Dr Roger Driscoll of NLP/RDW Associates, who will discuss the design of the new sound system in the Hall, and Mr Richard Cowell of Arup Acoustics

(Consultant to the National Theatre) who will speak on Auditorium Acoustics and the role of the sound system. The meeting will include demonstrations of the new sound system and will close with a panel discussion on sound systems in auditoria.

Meeting organiser: Peter Mapp.

Further details from ISCE, 47 Windsor Road, Slough. □



# Musical Instrument Acoustics

## Musical Acoustics Group Joint Seminar with the Institute of Musical Instrument Technology

THIS MEETING was held at the London College of Furniture on 19 March. It was organised by Dr J M Bowsher, Chairman of the Group, and the administrative arrangements and chairmanship on the day were undertaken by Mr J Lincoln, its Secretary. They had arranged an interesting selection of contributions representing recent advances in the fields of interest of the two Institutes.

The first paper, *Tone production in brass instruments*, by S J Elliott of the University of Surrey, was devoted mainly to the effect of lip behaviour on the pressure and velocity waveforms in the mouthpiece cavities. The alternating pressures in the two cavities were measured simultaneously while an instrument was being blown. The waveform was found to be highly dependent on frequency, being more sinusoidal at higher frequencies. The lips were open, and hence the mouth and mouthpiece pressures equal, for a greater proportion of the cycle at lower frequencies.

He defined the 'average resistance' of the lips as the pressure in the mouth cavity, measured by a water manometer, divided by the mean velocity, recorded on a hot wire anemometer. This parameter rose at high frequencies, and appeared to govern the change from low to high frequency behaviour in the waveform.

Using a simple mechanical model, the proportion of time for which the lips are open at different frequencies had been computed, and the results agreed with photographic measurements. The same was true of the variation with frequency of the effective mass of the lips.

Although this simple theory had been successful as far as it went, it needed further refinement in order for the musically important second-order effects to be studied. It was emphasised that these measurements were internal to the player-instrument sys-

tem, and could not readily be related to the external sound spectrum.

T Cord of Messrs Kemble then demonstrated the 'Pianocorder'. This US invention is an attachment which can be fitted into almost any domestic pianoforte, converting it to a reproducing piano with expression. Pre-recorded digital tape cassettes are used, which operate the keys and pedals of the instrument through a system of logic boards, relays and solenoids. Home recording is also possible, though not as satisfactory as the tapes produced on the firm's superior recording equipment. Most people would wish to use the system to simulate a professional performance on their own instruments.

The volume can be varied within normal piano limits, and the tempo within ten per cent either way. Since the dynamics are sensed by a single microphone, the loudness of individual notes cannot be varied, though there are independent treble and bass controls. The presentation ended with an impressive demonstration of the capabilities of the system as fitted to a small modern upright pianoforte.

The last paper of the morning session was *Integer and non-integer harmonic modelling* by R Gould of the London College of Furniture. This described recent work on the 'additive synthesis' of musical tones, as opposed to the Moog system which operates by subtracting information from complex waveforms such as square, sawtooth and triangular waves. There are limits to this method, which seem now to have been reached.

Computer aided analysis techniques now enable complex sounds to be analysed more completely, though the process is relatively expensive. Some results of such analysis of the attack, sustained tone, and decay of clarinet, trumpet and violin notes were shown. Variations in the relative intensity of harmonics during attack and decay were demonstrated, and it was sug-

gested that the attack ones were responsible for instrument recognition. It was already possible to synthesise very realistic tones from such information, but more research into the variation of frequency with time was needed.

In the afternoon, P S Watkinson (University of Surrey) spoke on *Materials in brass instruments*, a topic which he described as being full of bias, folklore and mystique. Materials seemed to be preferred by players and manufacturers for reasons other than musical ones. Factors which might influence the choice of material were discussed, including appearance, feel, and acoustic feedback.

Investigations had proceeded along two lines of inquiry. A variety of effects including viscosity, thermal energy transfer, friction, bore size and discontinuities was being studied using cylindrical tubes, and a theory had been produced which worked well for a smooth rigid bore. The method was being extended to investigate surface roughness, but broke down when the walls were far from parallel.

The other approach was using finite element analysis to investigate the structural vibrations of the walls of the instrument, in particular the bell. Using a large number of nodal points, a computer program predicted natural frequencies and nodal patterns. Vibration analysis applied to these results should enable the radiation of acoustic energy to be calculated.

Next, the Ellen dynamic transmission system for pipe organs was described. Its originator, Mr L Ellen, pointed out that, from an electrical engineer's point of view, the connections between the console and the pipes were essentially a system of about 500 switches, involving a 500-core cable. Now, by time-division multiplexing, it was possible to carry all this information on one pair of wires. Each channel was scanned at 50 Hz, and synchronised pulses transmitted indicating an 'on' or 'off' condition. Information about coupler operation was also sent. At the organ end, similar circuitry routed the pulses to electronic latches and relays to operate the pipes.

It was possible to record the information from the console for use at another time or place, and a fully polyphonic system using a solid-state memory was currently under development. Although the system was being put forward as an economical alternative to the traditional one, it was

sufficiently flexible for other facilities to be incorporated if required.

Finally, after tea, M McIntyre of the University of Cambridge spoke on *Recent progress in violin acoustics*. He began by saying that although improvements in instrument making were in sight, understanding of the interactions of player, instrument, auditorium and listener was still at an early stage.

Much work had been done on the resonances of the violin body and its air cavity, and vibrato was important here because of the movement of the harmonics with respect to the resonances. Although it was not clear why, some workers saw significance in the resonant frequencies and vibration patterns of the back and belly before assembly of the instrument. Free plate vibrations had been studied by various

methods and a simple theory for square plates developed which could be extended, given computer facilities, to violin-shaped plates. Further work needed to be done on the elastic and damping constants of anisotropic materials.

Other workers had come within sight of solution of some of the problems of the bow/string relationship, which was non-linear because friction did not depend simply on the relative velocity. Rosin increased the difference between static and dynamic friction. When the string slipped, a velocity discontinuity was propagated from bow to nut and back. On arrival at the bow again it triggered another pulse. Information on the torsional motion of the string was still needed.

Noise generation between bow and string had been studied, and its ap-

pearance seemed to be correlated with aperiodic 'spikes' in the bridge vibration waveform, and to be caused by the sticking and slipping of individual bow hairs. It could be reduced by tying the hairs together.

The meeting was a valuable continuation of the contacts between musical acousticians and instrument makers. The papers were well aimed at the mixed audience, and the time allowed to each contributor enabled full development of a theme, with ample use of visual and aural demonstration, though a little more time for questions, discussion, examination of exhibits and informal contacts would have been welcomed by some participants. Immediately following the seminar, an exceptionally well attended Annual General Meeting of the Musical Acoustics Group was held. ☐

F J Dibdin

## People Noise and Buildings

Building Acoustics Group Meeting 13 March 1980 at the BRE

THE DIRECTOR OF BRE, Dr I Dunstan, opened the meeting by inviting everyone to avail themselves of BRE facilities, not only during the day but at any time in the future. Dr Scholes then took charge of the meeting to outline the programme for the day. Lectures followed on *Noise and Schools*, *Party Wall Insulation*, *Noise from Neighbours and the Sound Insulation of Party Walls*, *Traffic Noise and Sleep*, *Noise in Cellular Offices* and *The Reliability of Noise Indices*. The first paper of the morning described a study undertaken to determine the disturbance caused to secondary school teachers by noise, particularly from road traffic. The schools in the survey were situated in the Greater London area north of the River Thames and in the counties to the north and west of London. A total of 73 schools were used in the final sample with 999 classrooms being exposed to levels from 50  $L_{10}$  dB(A) to over 70  $L_{10}$  dB(A).

A questionnaire was used to collect data from each teacher individually. The principal question about noise disturbance used a four point bother scale of 'not at all', 'a little', 'quite a lot' and 'very much'. After the questionnaire had been returned noise measurements were made outside and

inside each classroom and later analysed to give levels of road traffic noise in terms of  $L_{10}$  dB(A).

Mr I D Griffith asked about the type of schools in the survey. The fact that the survey had concentrated on Secondary schools was taken as the explanation of the good correlation down to 45 dB(A). Further questions led to discussions of the period for which the noise exposure had been calculated and whether the findings of this survey could be used other than in the traditional teaching environment of secondary schools. Dr Utley was asked if the survey had considered the response of the children, together with a further question on articulation. He replied that the children had not been questioned but he considered that the teachers' responses could have reflected to some extent the effects of noise on the children.

The second paper, on *Party Wall Insulation*, outlined the results of a field survey conducted by BRE since 1970. The survey results had been used to give a picture of overall performance, to provide data on the performance of individual constructions and to provide the objective data for the nuisance survey conducted by Dr John Langdon. The Building Regulations performance

standard was attained by only 45% of post-1970 dwellings. Many of the walls with the worst performance had special features which prevented the basic constructions achieving their full potential performance. An important finding of the survey was the large variability in performance found between nominally identical examples of the same construction. As dissatisfaction is most likely to arise from dwellings having performance at the lower end of the distribution, Mr Sewell said it may be better to describe performance by the level exceeded by 95% of examples rather than by performance.

Additional information, provided in response to questions, included statements that local authority dwellings predominated in the sample but that performance between privately built dwellings was very similar to that in the main group; that loft inspection had been used extensively to help to confirm constructional details and that mean performance had decreased concurrently with an increase in variability.

The third paper of the morning was presented by John Langdon, on *Noise from Neighbours and the Sound Insulation of Party Walls*. He explained that the present Building Regulations for sound insulation were based on the results of studies conducted over 25 years ago and the new study was intended to relate the current response of occupants to the insulation values measured in the recent objective survey. The study will include both party



walls and floors but only preliminary results for walls in houses are available. The occupants of nearly 1000 houses were interviewed and the questions covered a range of topics including neighbourhood quality and external noise as well as sound insulation. Although many occupants find it acceptable to hear some noise, 43% of the sample judged the sound insulation of their party wall to be below their expectations, and 36% rated it poor or very poor. A direct rating of insulation quality (on a 5 point scale) appeared to be a good indicator of quality. Subjective ratings of sound insulation appear to correlate well with physical performance expressed in terms of aggregate adverse deviation. However, even people in the best sound insulation group were not entirely satisfied, and this proved to be because they were bothered by structure-borne sounds such as doors banging or footsteps on stairs, while these impact sounds were apparently less obtrusive for people in lower air-borne insulation groups. Other physical methods of rating sound insulation may lead to better correlation with subjective response but this has not yet been investigated.

In the discussion on sound insulation the consensus view was that improved sound insulation control would necessitate a considerable review of the role of field measurements. The conclusions of a study by T J Schultz pointed firmly in this direction and recent experience in several countries confirmed that random testing of a small proportion of recently completed dwellings, associated with penalties in cases of detected failure, could lead to a major improvement in compliance rates. Simplified measurements were suggested as opening up the possibility of 100% performance checking but it would be important that measurement accuracy should not be sacrificed, or there would be an effective lowering of standards.

Workmanship, lack of adequate site supervision and failure to comply with the recommendations of materials manufacturers and other guidance were highlighted as major factors leading to the current situation. Performance checks in completed dwellings would help to reduce the incidence of these factors.

The last morning session, entitled *Traffic Noise and Sleep*, by Dr Wilkinson of the MRCU described the research he was carrying out upon the effect of traffic noise on sleep in the home. Similar investigations were be-

ing carried out in three other European countries, France, The Netherlands and West Germany, with the aim of providing a large bank of data for common analysis. The talk widened the scope of the day's meeting and a keen interest was shown in his slides and descriptions of the various stages of sleep his subjects experienced. Questions were asked on the number of subjects used and the length of time needed for the subjects to become familiar with the Noise/Quiet/Noise periods.

The first paper of the afternoon session, by Ted Keighley on *User Response to Noise in some Cellular Offices*, reported on a survey of user opinion about the noise climate in three groups of cellular offices. The survey covered 49 office rooms and 107 respondents and was carried out by means of self-completion questionnaires and informal interviews. Measurements of noise levels and the sound reduction between adjacent office rooms were also made for comparison with the subjective data. Results indicated that the great majority of respondents were satisfied with the

noise climate, except where excessive external traffic noise entered the building, and tend to confirm validity of the generally accepted design standard of limiting the ingress of traffic noise to 55  $L_{10}$  dB(A).

In presenting the last lecture of the day, *The Reliability of Noise Indices*, Ian Griffiths described an investigation into the seasonal fluctuation in noise exposure and noise annoyance. The predictive ability of annoyance scales used in social surveys is potentially much reduced by differences in response of individuals in the same noise exposure conditions but at different times. The development of more reliable measurements of annoyance could be tested by averaging across seasons. During questions, it was agreed that the effects on people of increases in noise levels are not yet clear; decreases however can be predicted from the steady state.

The meeting concluded with a lively and wide ranging discussion covering the whole field of topics raised during the day. □

A C Salvidge

## Elastic Wave Propagation and Scattering in Seismology and Materials Testing

27 February 1980 at Burlington House, London

THIS ONE-DAY MEETING, which was attended by over 100 delegates, was sponsored jointly by the Joint Association of Geophysics, the Materials and Testing Group of the Institute of Physics and the Institute of Acoustics. The meeting considered a range of very different wave propagation and scattering studies.

The meeting opened with an introductory talk by Dr J A Hudson (Cambridge University) in which he presented some of the geophysical background to the meeting, including a discussion of the various aspects of scattering pertinent to geophysicists.

The second contribution, by Dr K G Hall (British Rail), considered the observation of wave propagation by stroboscopic photoelasticity. It included the presentation of a series of

slides and a video tape which showed elegant visualisations of the complex wave fields generated by ultrasonic transducers, and both the scattering and the mode-conversion phenomena which occur when such wave fields interact with targets.

In the third contribution, Drs R J Dickinson and J C Bamber of the Institute of Cancer Research presented two theoretical and computational models of scattering from inhomogeneous media, the first being based on discrete scatterers and the second being an inhomogeneous continuum model. These have application to many problems, although the work was performed to explain the speckled appearance found in some ultrasonic B-scan pictures. The models presented included both tissue and ultrasonic wave field characteristics, and the results

obtained appear to be in agreement with features found in real B-scans.

Next Drs D J Buchanan, R Davis and P J Jackson of the National Coal Board reviewed the problem of fault location in coal seams. The results of studies using channel wave seismology, together with broadband numerical holographic mapping procedures, were shown to give maps of coal seams and to locate faults, at distances up to a few hundred metres.

Drs P J Newman and M H Worthington (Oxford University) then reported on a site investigation, with the use of a borehole geophone at various depths, of seismic body wave propagation and attenuation in heterogeneous media, this being a layered structure of sandstone over fractured chalk. Values of both compressional and shear wave attenuation within the media were obtained and these related to the causes of the attenuation.

The sixth contribution, by Dr N R Goulty (National Coal Board), reported on some poor quality seismic sections obtained when shots were fired in Bunter sandstone, a highly porous medium. The problems were reported as appearing to be related to effects in the region close to the shot.

This paper brought the morning session to a close and during the lunch interval a poster display by Drs R P Young, J R Coffey & J J Hill (Sunderland Polytechnic) on an empirical investigation into the relationship between seismic attenuation and geo-technical properties of rock masses was on show. This work involved the use of detailed attenuation information to characterise rock discontinuities.

The afternoon session opened with a

paper by Dr F J Sabina (Cambridge University) in which he reviewed the exact and the approximate analytical methods used to describe the scattering of SH waves at obstacles in a free surface. He then considered the application of Boundary Methods to scattering by shapes including semi-circular inclusions and a range of empty surface indentations similar to valleys and mechanical damage.

The next paper, by Drs M H Kazi and A Niazy from Saudi Arabia, reviewed the various analytical and semi-analytical studies that have investigated scattering of Love and Rayleigh waves at upsteps and welded quarter-spaces. This was followed by the presentation of a numerical study of Love wave scattering for welded layered-quarter spaces, using a scattering matrix method.

The third afternoon paper, by Dr J E Sinclair (Harwell) described a theoretical study to characterise metallic fracture from broad-band acoustic emission measurements describing the source as a simple dislocation and the specimen responses as that of an elastic half-space. The results obtained directly for histories of crack-opening volume and indirectly for crack areas and velocities were in quantitative agreement with those obtained from fracture mechanics.

This was followed by a theoretical analysis by Dr R C Chivers (University of Surrey) of the phase and amplitude fluctuations in inhomogeneous media.

The fifth paper, by Dr L J Bond (University College London) was a review of wave propagation and scattering studies that have used finite difference methods. The paper presented an outline of the basic technique applied to two-dimensional systems to

follow the time development of P-SV-Rayleigh waves or SH-Love waves scattered by such features as slots, or in layered media. Examples were then presented of its application to seismology, electronics (SAW devices) and ultrasonic non-destructive testing.

The final paper was by Drs J P Damiano and E Cambiaggio of the University of Nice, France and presented a finite difference model study of surface acoustic wave scattering from both steps and grooves, with variations in both feature dimensions and material properties. The model results were shown to be in good agreement with those of other studies.

The meeting was drawn to a close by Dr L J Bond (UCL) who collected together the common threads which ran through the meeting. The day's contributions could be grouped into three types of study, the analytical, the numerical model and the experimental, all seeking to investigate specific aspects of wave phenomena. Wave propagation and scattering forms a block of knowledge common to an otherwise diverse collection of subjects: seismology geophysics, both civil and mechanical engineering, ultrasonic non-destructive testing (of both man and machines), high frequency electronics and mathematics/applied mechanics, and he expressed the wish that in the future there would be increasing contacts and interchange of ideas.

The proceedings of the meeting will not be published, but copies of the book of abstracts may be obtained from Dr L J Bond in the Department of Electronic and Electrical Engineering at University College London. □

L J Bond

## Foreign Journals

Following an agreement between the Institute of Acoustics and the Academy of Sciences of the USSR, the two organisations are now exchanging the Bulletin and the Russian version of their Acoustics Journal:

**АКУСТИЧЕСКИЙ ЖУРНАЛ**  
**ВЫПУСК 2**

published by

**АКАДЕМИЯ НАУК СССР**

The Journal comes out about a year before the translation published by the American Institute of Physics under the title **Soviet Physics — Acoustics**.

Similar arrangements have been agreed for two other journals from abroad. The quarterly **Archives of Acoustics** is an English version of the Polish quarterly **Archiwum Akustyki**, which has been issued in Poland since 1966 by the Committee on Acoustics

of the Polish Academy of Sciences and the Polish Acoustical Society.

Acta Acustica, edited by the Acoustical Society of China, is published in Chinese but includes abstracts and contents lists in English. All three journals — along with *European Medical Ultrasonics* and the *Journal of the Audio Engineering Society* — will be held at the IOA Secretariat, to whom any enquiries should be addressed. □



# THE INSTITUTE OF ACOUSTICS

## SIXTH ANNUAL REPORT

### OF THE COUNCIL 1979

**T**HE PAST YEAR has seen major changes in the administrative organisation, in the publication policy, and in the financial outlook of the Institute. Escalating service costs, together with certain recurring criticisms of the service provided by the headquarters office in Belgrave Square, led Council to seek alternative professional arrangements. Consideration of four tenders produced a decision to move the office to Edinburgh, and to appoint a new Secretary, Mrs Cathy Mackenzie. The registered office was relocated at the office of the auditors.

Dr H G Leventhall dutifully accepted Council's invitation to fill the onerous office of Honorary Treasurer. Having reviewed the financial position he warned Council that the prognosis was very poor. The position could be attributed largely to a combination of rising service costs, and default on subscription payments by a large number of persons who had remained on the membership list, and to whom services, including the provision of publications, were still being offered. The cash position was so serious that Council reluctantly decided to raise the 1979 subscription retrospectively, and to request payment of the 1980 subscription in advance: in addition a final notice was sent to members in default. As a result the Institute was able to end the year in a less serious state than would otherwise have been the case, and with a far more healthy outlook for the coming year. Council wishes to express its appreciation of the enormous efforts made by Dr Leventhall and Mrs Mackenzie to re-establish the Institute on sound financial and administrative footings.

Publications constitute the largest single item of the running costs of the Institute, and it was clearly necessary to reconsider publications policy in association with other moves to reduce expenditure. As a result, Council announced that in future the four-page proceedings of meetings would not be automatically communicated to each member, but would be produced as pre-prints for those attending meetings, and will be available for purchase by all members. Abstracts of all papers will be published in the *Acoustics Bulletin*, which will continue to form the main channel of communication between the various committees and the membership, and among individual members.

This year saw the retirement of Dr M E Delany from the editorship of the *Acoustics Bulletin*, and his succession by Mrs F A Hill. Dr Delany has been editor since the inception of the *Acoustics Bulletin*, and Council wishes to place on record the immense debt of gratitude owed to Dr Delany for many years of devoted and skilful work which have ensured the successful development of this vital element in the life of the Institute.

As a result of the reception of numerous requests of the secretariat for information and guidance, Council has approved, in principle, the preparation of a professional register of consultants, manufacturers and agents in the field of acoustics. Publication of the prepared lists is subject to legal advice. Council has agreed that the Institute of Acoustics should join International INCE.

Council wishes to acknowledge with gratitude the services of Mr R M Taylor who has borne the burden of the office of Honorary Treasurer since, and even before, the inception of the Institute of Acoustics. The services of Professor P E Doak, who has retired from Council after a number of years, are also recognised.

At the close of the year the total numbers of corporate and non-corporate members stood at 626 and 311 respectively.

#### STANDING COMMITTEES

The operation of the Institute is carried out by Council through the following Standing Committees: Meetings, Membership, Publications, Diploma Advisory and Examination Boards, and Medals and Awards.

#### Meetings

The two major meetings of the year were the Spring Conference at Southampton University and the Autumn Conference at the Hydro Hotel, Windermere. Both were particularly successful events in every sense with encouragingly high support from the participants and exhibitors.

The Autumn Conference represented a departure from previous practice in a number of aspects. In previous years there had been a suggestion that September was not the most suitable month because of problems caused by the summer holidays and

accordingly a November date was selected largely to test support for such a change. This excluded normal University venues and although this was outside the experience of the Meetings Committee a hotel venue was chosen. Fifty-five papers were presented and the total of participants, wives, exhibitors and visitors exceeded 150. The meeting was jointly sponsored by the British Society for Audiology and the success of the venture encourages the Meetings Committee to look forward to joint major meetings on the same basis in future.

Among the other meetings which have come directly under the Meetings Committee's responsibility have been a two-day meeting at Cambridge on Source Location and Active Control of Noise, and at Chelsea College on Acoustic Emission and Materials Evaluation, and one-day meetings on Acoustic Test Facilities, Non-physical Aspects of Noise Criteria and Noise in Large Cities: the Chelsea meeting attracted a large number of foreign contributors. A high standard of contributions and support may be reported in all these events. Preprints of the contributions have been made available to participants in these meetings in the form of an A5 size meeting booklet prior to appearance in the Annual Proceedings of the Institute; this arrangement is proving convenient and popular in relaxing the time scale organisers have to adhere to.

The London Evening Meetings have continued to play a most valuable role in the Institute's meetings programme. These are held at County Hall, London, on an informal basis and are considered a particularly worthwhile feature by those able to attend. The organisers are to be congratulated upon their zeal and the consequent success of their programme.

### **Membership**

Apart from its regular task of considering applications for membership and for regradings, the Membership Committee has considered other aspects within its terms of reference such as membership recruitment and membership statistics. The application forms for all grades of member have been revised and approved, and it is hoped that these prove to be more straightforward to complete and more effective. A broadsheet has been produced to assist recruitment for distribution to enquirers at meetings, conferences, or by post, etc, which lists the benefits of membership and defines the various grades of membership and designatory initials which apply.

The Committee has recommended that on all Institute literature, including papers at meetings, etc, the designatory letters for the corporate grades (FIOA or MIOA) should be used where appropriate, and we hope that all our corporate members will use these initials after their names whenever possible to help publicise the Institute.

Council has agreed that applications for Associate and Student membership can be dealt with more expeditiously than those for Member and Fellow

and hopes this will save time in processing many such applications.

The Committee wishes to draw to the attention of all members the fact that the Institute welcomes Sponsor Members from companies, consultancy practices, etc, with an interest in acoustics in its broadest sense. By assisting the development of the Institute such Sponsor Members are assisting in the growth of meetings, publications and knowledge in the field of acoustics which must either directly or indirectly assist them also.

### **Publications**

Several changes have taken place during the year. In the first place the Committee should thank Dr Delany, the retiring editor of the Bulletin, for all the work he has done to set up the new form of Bulletin and sustain the high standards set by the first editions. The Bulletin will continue to be the main form of communication with all the membership.

This year saw the appearance of the first of the bound volumes of Proceedings. Unfortunately the high cost of providing full copies to all members has meant a reappraisal of policy. This was discussed at the special general meeting in November. The agreed revised policy is that all papers to be presented at formal meetings of the Institute will have an abstract printed in the Bulletin. Thus all members will still receive information on all papers presented. The four-page versions of the papers will then be available for those who attend the meetings and bound volumes will be prepared for sale to libraries, etc. The same applies to volumes of medal lectures. This will cut the cost considerably but will still make the information available to those who need it. Originals of the papers will be held and so it will be possible to make limited print runs of earlier volumes as the sales to libraries build up.

### **Diploma**

During the year Mrs Sheila Stern has replaced Mr Frank Reynolds as the representative of the Noise Advisory Council on the Diploma Advisory Board. In addition Mr John Hay has joined the Board to represent the CEI. Representation now includes: Association of Noise Consultants, British Society of Audiology, CEI, Environmental Health Officers Association and Examination Boards, Health and Safety Executive and Noise Advisory Council as well as the IOA. The Board's terms of reference were agreed by Council to include liaison with other bodies and make recommendations on the development of the Diploma.

The year has seen an increase in Colleges approved to run the Diploma to include: Bristol Polytechnic, Cornwall Technical College, Derby Lonsdale College, Leeds Polytechnic, Liverpool Polytechnic, Newcastle Polytechnic, North East Surrey College of Technology, Robert Gordon's Institute of Tech-



nology and Tottenham College of Technology. It is expected that the geographical gaps in the Edinburgh and Northern Ireland areas will be covered in the near future.

The number of entries in the 1979 examinations rose to 80 compared with 56 in 1978. The results showed a very high standard of teaching at all colleges and the Institute's prize for the best student was awarded by the Examination Board to Mr M Rowlands, an Environmental Health Officer who studied at North East Surrey College of Technology. The Association of Noise Consultants awarded a prize for the best project to Mr M J Beasley who studied at Liverpool Polytechnic.

An additional specialist module has been devised on Vibration Control to start in September 1980 and discussions on an Industrial Audiometry module are continuing. Modifications to the Course are proposed to start in September 1980, including moving the date of the General Module examination to Easter.

#### **Medals and Awards**

The 1979 Rayleigh Medal was presented to Dr E A G Shaw of the National Research Council of Canada on the occasion of his lecture to the Spring Conference. The A B Wood Medal and Prize were awarded to Dr Peter H Rogers of the Naval Research Laboratories, Orlando, Florida.

### **BRANCHES**

#### **North Eastern Branch**

Bad weather severely reduced the programme during the early part of the year. The Branch held Acoustic Forums at Carlisle in April and Darlington in May. At these meetings panels of four acoustic experts answered questions and discussed comments submitted by the audience. The meetings were most lively and the exercise was very worthwhile.

The 1979/80 session opened with an excellent talk by Mr P Newall of the North Riding Infirmary on *Assessment of Hearing Loss*; in December a speaker from Leeds gave an interesting lecture/demonstration on *Speech Synthesis*. This was held jointly with the local branch of the Institute of Physics; as usual with joint meetings, it was very well attended.

The Committee has made representations to the Council regarding Branch and Group policy.

#### **Southern Branch**

During 1979 there was a programme of five lectures, one film evening, two industrial visits, a social evening and one one-day conference in conjunction with the Institute. Attendance figures have been fairly constant at about 13-15. The one-day conference on *Non-physical Aspects of Noise Criteria* had an attendance of about 40 persons. Success at the meetings did depend on publicity and it was costing at least £12 for all the Southern Branch to be informed of meetings, with a mailing list of about 120.

Considerable support was derived from visitors to the meetings. The Social Evening held in February was considered successful with about 100 people attending. At the Annual General Meeting Dr J Powell was re-elected chairman. He has made representations to the Council regarding relationships of the Branches and the main body of the Institute.

### **GROUPS**

#### **Building Acoustics Group**

The first overt activity in 1979 was the organisation of two sessions of the Spring Meeting of the Institute at Southampton.

Group members attending the meeting were invited to an open discussion on the Group's activities, and a number of suggestions emerged, some of which will be bearing fruit shortly, including special events at the 1980 Spring Conference. The resignations of Robin Mackenzie, the founder, secretary, and of Chris Walker from the Committee were received with regret; Dr David Fleming has succeeded as secretary, and Paul Newman rejoins the Committee. The watch on British and International Standards started by Chris Walker is being continued.

The most important event of the year was the two-day conference in Edinburgh on *Room Acoustics with Emphasis on Electroacoustics*. This first big independent venture was timed to coincide with the Edinburgh International Festival, making a social programme superfluous, and proved very successful. Acoustic scale modelling seemed to be the single topic of greatest interest and growth, and the meeting was notable for starting the series of informal workshops which are being continued by the Group.

Shortly afterwards, a further workshop was held in the National Theatre, bringing together a number of architects, acousticians, and other specialists intimately concerned with recent theatres and other auditoria. The three theatres of the venue served as a focus for the discussions, but, owing to the difficulty of holding a meeting and technical visit in such a busy complex in the middle of its normal activity, it was reluctantly decided to limit attendance to 30 invitees together with those who had expressed interest after the preliminary announcements.

#### **Speech Group**

Only two technical meetings of the Group were held in 1979. The first, at Edinburgh University in February, was on the subject of *Speech Acoustics and Speaker Characteristics*; four papers were presented, from Cambridge University, University College (London), Joint Speech Research Unit and Leeds University.

At the second meeting, in August, at Leeds University, the Group was able to benefit from the presence in the UK of many foreign research workers on their way to the International Phonetics

Congress in Copenhagen. The subject was *Speech Production Modelling*, and six papers covering various aspects of this field were presented, including two from the USA.

The Group's main scientific activity of the year, however, was its participation in the speech sessions of the Institute's Autumn Conference at Windermere, where a total of 20 papers on speech communication were presented by authors from all over the UK as well as a few from overseas.

The year has seen the retirement from the Committee of the Group's former Secretary, Celia Scully, to whom appreciation is due for the hard work she put in during the first few years of the Group's existence.

The Group's membership continues to increase slowly, but many of those who regularly attend meetings are still non-members. Their formal membership would ensure that their views could influence the Group's programme, and improve the future health of the Group and of the parent Institute. All members are therefore urged to encourage any non-members who are interested in the Group's activities to join.

#### **Underwater Acoustics Group**

The following technical visit and conferences were organised during the year: Technical visit to AUWE Portland and to Plessey Marine, Templecombe, in June; *Underwater Applications of Non-Linear Acoustics*, University of Bath, in September; *Progress in Sector Scanning Sonar*, MAFF, Fisheries Laboratory, Lowestoft, in December.

The conference on *Non-Linear Acoustics* at Bath attracted 60 registrants drawn from many countries. The conference proceedings were available during the conference, a practice which the Committee favours pursuing in future. Reports of the conference have appeared in *Ultrasonics* and in *Acoustics Bulletin*. The *Sector Scanning* meeting at Lowestoft attracted 54 delegates. However, it was with regret that the Committee learnt of the illness which prevented Dr Voglis from attending. Once again the proceedings of the conference were available at the conference.

The Publications Secretary, J Mills, has established an excellent service for the supply of Proceedings of past meetings and has received quite a healthy demand. The practice has now been established by the Committee of sending a copy of the Proceedings of every meeting to the National Lending Library at Boston Spa. In view of the financial situation of the Institute, it was decided by the Committee to shelve plans for the distribution of Proceedings to all members of the Underwater Acoustics Group at reduced cost for the present.

An up-to-date list of the members of the Underwater Acoustics Group shows that there are 49 members. It is the policy of the group to make available information and membership application forms at conferences.

The Group Committee have been pleased with the responses from the Institute since its move to Edinburgh. The Committee welcomed the relaxation of age qualification for the AB Wood Prize Nominations, and strongly felt that the stature of the medal and its recipient be mutual.

#### **Musical Acoustics Group**

Regretfully the Musical Acoustics Group has not been very active during the past year. This has been partly due to force of circumstances and partly to the fact that some planned activities are taking place in the current year rather than in the year under review. However, an interesting and successful visit took place in June to the organ works of Peter Collins at Redbourn, near St Albans. This provided an opportunity to observe the techniques of organ construction and to hear some of the results.

In view of the wide geographical distribution of the relatively small Group membership, it is not possible to hold frequent technical meetings. The policy of the Group Committee is to hold fewer, large meetings in conjunction with other bodies or as part of a major Institute conference. Group membership for the year was around 50.

#### **Industrial Noise Group**

During the early part of 1979 the Industrial Noise Group was without the services of its founder member Dr P Wilcox who spent some time in Australia on sabbatical leave lecturing at Sydney University and in his absence the secretarial duties were undertaken by Mr T Kelly.

Following a number of cancellations the Industrial Noise Group held its first meeting at Whitbread Brewery which was supported by twelve members. The trip was very successful giving members the opportunity to experience a modern brewery which had paid special attention to noise control and also featured an impressive aesthetically designed acoustic ceiling.

The second visit was an integral part of the IOA annual conference at Southampton which gave members the opportunity to meet and discuss topics of mutual interest on an informal basis.

In the summer months an analysis of the Industrial Noise Group's membership was undertaken on a geographical basis and the results have just been published in the *Acoustics Bulletin*. To supplement this information a questionnaire was designed and circulated to members in order to establish the chief areas of interest. Analysis of the response to the questionnaire is currently in progress and the results will be combined with those of the membership distribution to form the basis of deciding on future meetings and appropriate venues.

The third meeting of the Industrial Noise Group was held at Chloride Industrial Batteries Limited where sixteen members heard brief lectures by both



management and the local Environmental Health Department on the environmental problems associated with this fairly new factory and in particular the noise pollution aspects. The success of the venture was self evident during the tour of the works which followed.

#### ADMINISTRATION

Council wishes to acknowledge the efficient services of the Secretary, Mrs Cathy Mackenzie, and her assistants, particularly in regard to the extensive reorganisation of membership records together with prompt and courteous handling of enquiries. The Institute is indebted to the Heriot-Watt University authorities for the provision of headquarters

accommodation.

#### THE YEAR AHEAD

Although the financial course of the Institute was recharted during 1979, the fundamental need for an increased membership remains. The efforts of members of Groups and Branches in promoting meetings of high quality are undoubtedly a major factor in attracting new members. While the achievements of the past year are to be applauded, they are often the result of the hard work of small numbers of individuals. By offering their services to group and branch committees members can play a more active role in the life of the Institute; they can be certain of a warm welcome from the faithful few. □

## Honorary Fellows of the Institute of Acoustics

### Professor John Lamb

Professor John Lamb received his secondary education at Accrington Grammar School, after which he joined the Electrical Engineering Department at the University of Manchester where he graduated with First Class Honours in Electrical Engineering and was subsequently awarded the MSc and, in 1946, the PhD for a thesis entitled *On the Measurement of Dielectric Properties at High Frequencies*. In 1947 John Lamb joined Professor Willis Jackson's Electrical Engineering Department at Imperial College and it was here that he developed his interest in ultrasonics. He built up a strong and active research group of worldwide reputation with particular emphasis on ultrasonic investigations on viscoelastic proper-

ties of liquids and polymers. He later moved to Glasgow University where he is the James Watt Professor of Electrical Engineering and Vice-Principal of the University. At Glasgow University his rheological work has been extended to higher frequencies and pressures.

John Lamb has throughout maintained an active interest in education and has served on the committee of a number of scientific societies and he was recently President of the British Society of Rheology. It is also to be recorded that he has now passed his century of scientific publications, of which ninety per cent are devoted to ultrasonics.

In recognition of the outstanding contributions to acoustics Council is glad to elect Professor John Lamb an Honorary Fellow of the Institute of Acoustics.

### Professor William Taylor

Professor William Taylor was born in Lerwick and received his early schooling in Kirkwall and Wick. After graduating with an honours degree in chemistry in 1934, and gaining a PhD in 1937 at Edinburgh University, Professor Taylor joined ICI Nobel's Explosives as a research chemist. During World War II he held the post of Plant Manager in Explosives at the Ministry of Supply Factories at Irvine, Dumfries and Arran. In 1945

he returned to Edinburgh to take a medical degree and then followed two hospital posts. At the end of that period he served for eight years as a general practitioner in Castletown, Caithness.

His interest in occupational medicine began with an appointment in 1960 to Professor Alex Mair's department of Social and Occupational Medicine, University of Dundee, with an additional appointment in charge of the medical department of Jute Industries Ltd. He obtained the MD with commendation in 1968 for a thesis on *Noise Induced Hearing Loss* and was later elected to the Chair of Occupational Health, University of Dundee. His research interests were, and still are, in noise and vibration and the toxicology of heavy metals, lead and mercury.

Professor Taylor retired from the University at the end of September 1978 and is now living and working still in Caithness, where his concern for the medical welfare of his fellow men found its first full expression.

Council wishes to recognise the outstanding contribution of Professor William Taylor to the cause of elucidating, and minimising, the risks to the health of men and women employed in industry by electing him an Honorary Fellow of the Institute of Acoustics.



*Prof John Lamb and Prof William Taylor in cheerful mood at the Spring Conference on their election to Honorary Fellowship of the IOA*

**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 29 August.**



# Proceedings of The Institute of Acoustics

## ABSTRACTS

### Low Noise Automotive Diesel Engines

**Low Noise Automotive Diesel Engines**  
**G E Thien and H A Fachbach**  
**AVL, Austria**

Starting with the limited acoustic effect of improvements to individual engine and vehicle components this paper deals with the possibilities of an essential reduction of engine and vehicle noise. This requires considerable modifications to engine design.

These highly effective measures represent the only possible way to reduce effectively the environmental annoyance due to traffic noise. As far as the engine itself is concerned, this goal can only be achieved by applying the principle of vibration isolation of exterior surfaces.

In practice two engine concepts are available: full enclosure of a conventional engine, or alternatively a completely new engine design philosophy. The essential feature of the latter is the vibration isolation of the crankcase and gearbox from the vibration excited engine structure.

Regarding the total effect of noise reducing measures, other noise emitting sources must also be taken into consideration. These are accessories such as intake, exhaust and cooling systems. As is shown in the paper the noise produced by these components can be reduced in an economical way to the same level as that of the low noise engine transmission unit.

**Obtaining Good Experimental Data for the Mathematical Modelling of Engine Structures**

**R Williams, J M O'Keeffe and J T Mathews**  
 External noise legislation and the demand for lower interior noise levels have put manufacturers under increasing pressure to reduce the emitted noise from their engines. This paper describes a combined analytical and experimental approach that allows the designer to optimise the effects of possible modifications, such as increase of stiffness, damping or mass, on structure borne noise, without recourse to a series of expensive hardware changes. In particular the addition of beam stiffeners to various areas of the engine block and lumped damping material can be readily

evaluated. To demonstrate the application of this approach samples are given of engine system models obtained from mathematically combining either the measured or calculated dynamic characteristics of the engine component parts. Vibration reductions are related to noise reductions by the use of space averaged velocities as part of a statistical energy method to calculate radiated noise.

**Gear Impact Noise in Diesel Drives**  
**J D Smith**  
**Cambridge University**

If it is suspected that impact between gears is contributing to noise from a gear system, correct diagnosis is essential. Loss of contact may be occurring predominantly due to external excitation, ie the engine, or due to lack of smoothness in the gear drive itself.

Engine excited impacts can usually be recognised since they tend to occur only at very light loads and during deceleration in the cycle whereas gear excited impacts may occur anywhere during a revolution and can occur at all loads. The pattern of vibration may be extremely regular, particularly with high quality gears, or may be erratic with normal commercial gears.

Deciding whether a particular case involves loss of contact or not is difficult; the presence of a jump or a warble in the noise output indicates loss of contact clearly but frequency analysis of the sound or vibration is of little help. Inspection of the recorded vibration is also of little use since the signal may or may not repeat exactly each revolution both for loss of contact or continuous contact cases.

Since vibration and noise analysis is of limited help there are two possibilities left. The first is to measure transmission error in the drive in position on the engine and loss of contact and the subsequent impacts may then be seen clearly. This method is very powerful and effective and also gives information on the manufacturing accuracy of the gears but the grating equipment is expensive and will not measure frequencies above about 600 Hz which greatly limits its application.

The alternative is to measure the system transmission error at the manufacturing stage and to predict from the gear transmission error and the engine torsional vibration when (or whether) the gears will lose contact in service. This involves having at least a rough idea of the dynamic response of the gear drive.

Once a clear idea of the mechanism of the noise generation has been achieved the possible solutions of frequency moving, absorption damping or alteration of gear design or manufacture can be assessed.

**Transient and Steady Noise in Automotive Diesel Engines**  
**J Challen**  
**Ricardo Consulting Engineers Ltd**

The increased noise level from diesel engines when accelerating has been known for many years. This paper examines the contributions of both combustion and mechanically induced noise for engines running at steady state and under accelerating conditions.

The method of separating combustion and mechanical noise is detailed, together with a method of estimating the combustion noise from rate of cylinder pressure rise. The importance of piston slap under transient conditions is shown, together with methods of reduction.

**The TRRL Quiet Heavy Vehicle Project**  
**A R Cawthorne**  
**TRRL**

The objective of the project was to produce demonstration articulated vehicles with external noise levels reduced to 80 dB(A) on drive past. The interior noise level target was to be 75 dB(A). The resulting vehicles were to be suitable for commercial series production and normal operation.

Research at ISVR, MIRA, NEL and TRRL led via experimental components and vehicles to one final demonstration vehicle based upon a Foden/Rolls Royce tractor capable of 38 tonnes GCW. This met the noise targets by the use of specially designed engine, cooling, exhaust, engine

## Noise Control in Hospital Buildings

enclosure and cab. The cost and weight penalties involved have been related to the degree of quietening and do not exceed 8% of cost and 0.8% of GCW for the 80 dB(A) vehicle.

The demonstration vehicle is currently in service on general haulage and is being carefully monitored to provide final information on the durability of the noise reduction measures and any indication of the effects upon maintenance and running costs.

The paper traces the development of the experimental engines and vehicles which led up to the demonstration QHV and provides an initial assessment of the results of the in-service trials.

### Appraisal of Test Procedures Applicable to the Measurement of Diesel Engine Noise

**D T Aspinall, MIRA**  
**R Pettiit, Perkins Engines**

With noise legislation becoming increasingly stringent, it has forced engine and vehicle manufacturers to investigate all possible methods of reducing the overall noise levels emitted. Although at present legislation does not cover noise levels emitted from a bare engine, it is a primary source of overall vehicle noise and therefore any attenuation of engine noise is advantageous.

Currently, a number of different procedures exist which have been developed to determine the noise level emitted by an engine. In the past, noise levels have been quoted under different standards and this has led to an ambiguous and misleading interpretation of results. Direct comparison of noise levels obtained for different engines under different standards has not been totally valid.

The aim of this work is to compare the engine noise test procedures available. The work involves measuring engine noise,

both in the engine noise test cells and under free field outdoor conditions, using the required number of microphones and microphone positions as mentioned in the standard procedure. Noise levels are determined in terms of both sound power and sound pressure levels.

### IC Engine Combustion Noise and Methods for its Reduction

**D Anderton**  
**ISVR, University of Southampton**

The paper considers the general aspects of combustion induced noise and summarises some models for its prediction. The effect that the major combustion chamber designs have on combustion noise is qualified and its relationship with engine performance noted. Once a particular form of combustion chamber shape has been decided on then control of combustion noise can be obtained by the matching of swirl, injection timing and rate and nozzle configuration. The use of turbocharging for noise reduction is important and its limitations in this respect are discussed, together with some theoretical studies regarding smooth cylinder pressure diagrams excitation. Finally, the general parameters controlling combustion noise are outlined and discussed in relation to other engine design goals.

### Computer-aided Method to Optimise Diesel Engine Piston Design for Low Noise and Frictional Losses

**G Gerrard, D A Howard and S D Haddad**  
**Loughborough University of Technology**  
**M F Russell**  
**Lucas CAV Ltd**

A mathematical model of piston motion in a diesel engine has been developed and implemented on a digital computer. This has been used to predict the effect of

design and operating variables (such as gudgeon pin offset, piston centre of gravity offset, piston to bore clearance, hot bore shape and oil film behaviour) on noise due to piston slap. Consequent changes in frictional losses are also considered.

It is shown how the use of certain graphical techniques enables the analysis of the results to be simplified. A procedure for finding the optimum piston design for low piston slap and frictional losses is also described.

### Problems Associated with Vibration and Internal Noise Levels on the Hovermarine HM2 Sidewall Hovercraft

**A F White**  
**Vosper Hovermarine Ltd**

A brief description is given of the Hovermarine HM2 sidewall hovercraft (with high speed lightweight diesels for lift and propulsion).

Noise problems on HM2 are described and measurement and identification of noise sources discussed: primarily

- (a) main engine;
- (b) transmissions and V gear boxes;
- (c) lift engine and hydraulic motors.

Measures taken to reduce noise and vibration are described, together with successful reductions achieved. Finally the present state of the art is reviewed.

### Quieter Diesel Engines

**M F Russell**  
**Lucas Industries Noise Centre**

This paper examines the reasons for controlling noise from diesel engines to show how realistic targets may be set. It presents a framework for the study of diesel engine noise and summarises the work which has been done to control noise, with reference figures by which other results may be judged.

# Noise Control in Hospital Buildings

## Noise Level Analysis

**R Lawrence**  
**Institute of Acoustics**

The rationale underlying a number of the noise criteria most frequently encountered in everyday practice will be reviewed in relation to their definitions and the need they are intended to satisfy. Relationships between the criteria will be examined along with subjective aspects and, where appropriate, experimental evidence underlying their use.

The adequacy of  $L_{eq}$ ,  $L_{ax}$  exceedence levels, NC and NR values will be considered in relation to the specific aims of noise control procedures relevant to hospital buildings and services. Problems specific to low frequency noise annoyance will be reviewed together with work presently in hand that will clarify the situation.

## Noise Measurement Techniques and Instrumentation

**P R Draper**  
**B & K Laboratories Ltd**

When carrying out noise measurements it is important to know the theory of noise propagation, the relevant standards to be adhered to and to choose the correct microphone and associated instrumentation for the job in hand. It is also very important to make proper documentation upon which later evaluation of the measurement results can be based.

This lecture will discuss briefly the proper use of the techniques and instruments available for the measurement of sound, with particular reference to the correct calibration and the use of microphones (the most important link in the measurement chain!).

We shall also discuss briefly the correct application of various measurement systems, such as: Sound Level Meters,  $L_{eq}$  Measurement Systems, Statistical Analysers, Tape and Graphic Recorders, Sound Power Measurement Systems and 'Real Time' Spectrum Analysers.

## Environmental Noise Requirements

**A J Jones**  
**Acoustical Investigation and Research Organisation Ltd**

New hospital projects present the designer with a wide range of considerations in the field of noise control in view of the spectra of necessary activities and varying sensitivities of the occupants. Problems due to noise from common environmental sources, such as road, rail and air traffic, can be compounded by the increasing use of in-



dustrial plant and mechanised equipment in and around the hospital itself. For some hospital patients a quiet environment may be essential to recovery, whilst for others, for example in many children's or geriatric wards, a lively day-time climate seems to be a necessary tonic. Medical and nursing staff will require suitable conditions for concentrating on their daily tasks, with privacy a prime objective for consultations and examinations. Living accommodation for medical staff is often provided on the hospital campus and the provision of an acceptable noise environment in staff quarters should form part of the overall noise control plan.

This paper describes the range of requirements for environmental noise control in modern hospitals, drawing attention to the

importance of early consideration of noise as an important factor in the design processes when both site and detailed planning can maximise the benefits and minimise the cost of this aspect of the project.

### Selection of the Correct Attenuation Equipment

#### A Nethersol PAR Acoustics Ltd

As noise control has advanced, more and more parameters have to be considered when selecting air flow attenuators in engineering.

Apart from the obvious acoustical controls of insertion loss, static and dynamic, and frequency, the location of the attenuator and its physical design become equally

critical in some circumstances.

The paper will attempt to highlight certain significant trends in both areas and pinpoint, in some instances by case history, the main pitfalls to be avoided.

The development of the most common dissipative attenuator will be followed and latest trends of attempts to time such an attenuator discussed.

Related as it is to Hospital Engineering, the paper will concentrate on three areas where noise control is usually considered:

- (a) Ventilation or air conditioning systems.
- (b) Ancillary plant — cooling towers, chillers, boilers, etc.
- (c) Diesel generator plant, engine exhaust and cooling air attenuators.

## BUILDING SERVICES NOISE CONTROL

### ARUP ACOUSTICS

13 FITZROY STREET, LONDON W1P 6BQ

Arup Acoustics are looking for a Building Services Engineer with a broad interest in practical acoustics and a particular knowledge of noise control.

Applicants should have a degree and/or Membership of an appropriate Institution. They should have had a minimum of five years design experience in Building Services, and have taken full responsibility for noise control for two years.

Please apply in the first instance, enclosing full c.v. and quoting ref. AAC (80), to: Tom Henry, Staff Manager, Ove Arup Partnership, 13 Fitzroy Street, London W1P 6BQ.

# Noise and Vibration Engineers Acoustics

Atkins Research and Development is a major consultancy serving a wide variety of clients in the UK and overseas. Projects involve the investigation and control of noise and vibration from industrial sources, manufactured products, transportation systems—road, rail and air, and within buildings and offshore installations.

We are currently seeking engineers who have a degree in an engineering or similar discipline and have been trained in a noise and vibration field. The senior position would suit a person with five or more years' experience in noise control, and other positions those with three to five year's experience. The work is interesting and challenging; the opportunities to exercise

initiative are considerable.

A good remuneration package includes total re-location expenses among other appropriate benefits.

Our base at Epsom provides a very pleasant working environment on the edge of the Downs and within easy reach of London.

If you would like more details, please phone Mr T K Willson at Epsom 26140, ext 2308, or write, quoting ref: AB, to Mr J B MacRitchie, Personnel Adviser, Atkins Research and Development, Woodcote Grove, Ashley Road, Epsom, Surrey, KT18 5BW.

**Atkins Research and Development**

*The Queens Award for Export Achievement to the WS Atkins Group*



# UNDERWATER RESEARCH

## SECTION HEADS · SENIOR ENGINEERS · ENGINEERS

We are looking for mathematicians/physicists with experience of mathematical modelling techniques. Your field of activity is less relevant than the type of experience gained and could include seismology, military oceanography, aerodynamics, scientific research or performance monitoring in the petro-chem or similar industry.

Our clients are Sperry Ltd who are leaders in the design and manufacture of below the sea defence systems. The area of work will include:

### Mathematical Modelling/Simulation Military Oceanography Feasibility Studies

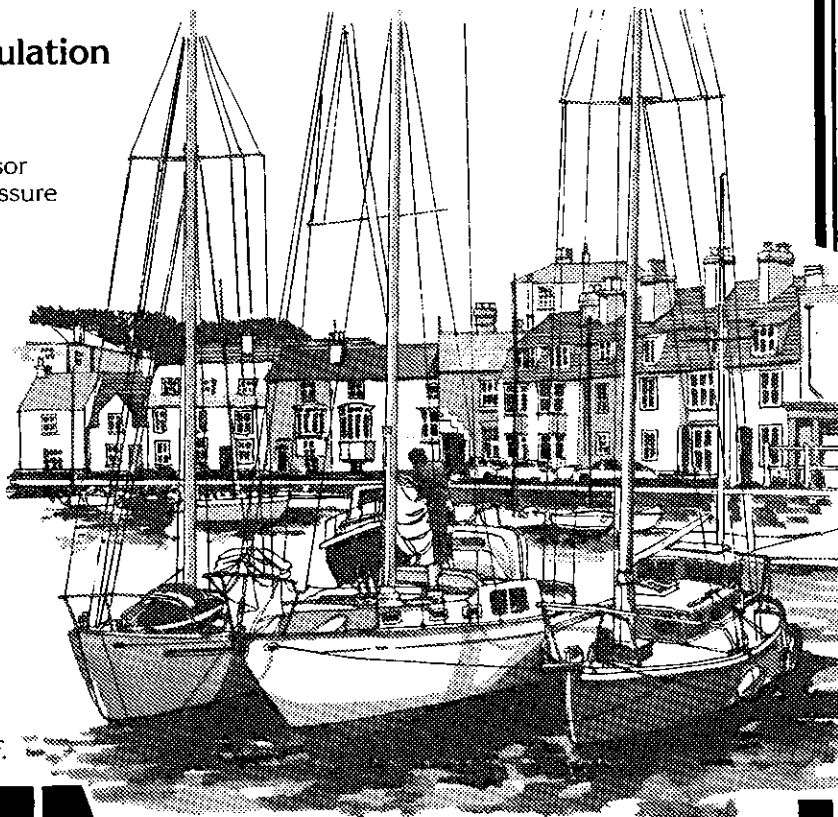
The Underwater research will focus on sensor performance and characterisation (magnetic, pressure or acoustic) and military oceanography.

You will have a relevant degree in mathematics, physics or another science subject. The more senior positions will require several years experience in a relevant field of work. The vacancies exist at the design and development unit at Weymouth, Dorset, one of the most attractive working locations on the South Coast.

A competitive salary and good promotion prospects are offered, together with assistance with relocation expenses in appropriate cases. Other benefits include pension and life assurance scheme.



Contact Tony Mason, (0703) 38211,  
PER, 62-64 High Street, Southampton, SO9 2EF.



To: Tony Mason, PER, 62-64 High Street, Southampton, SO9 9EF, Hants. I am interested in working for Sperry in Weymouth. Please send me an application form and information package.

Name \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Phone No. \_\_\_\_\_

Present job title \_\_\_\_\_

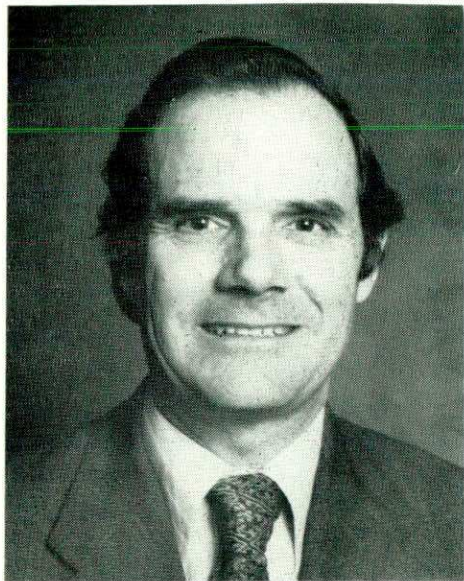
Current Salary £ \_\_\_\_\_

**PER**  
Professional  
& Executive  
Recruitment



# ***The Honorary Officers of the Institute of Acoustics***

**President**  
**Brian Clarkson**



After graduating in Civil Engineering at Leeds University, Brian Clarkson continued at that University to do research in structural dynamics, and subsequently joined the de Havilland Aircraft Company to work on dynamic problems of aircraft structures. During this time he became involved in jet noise and its effects on aircraft structures. Thus began his connection with acoustics and the foundations of his professional career in random vibration. In 1957 he moved to Southampton University to join Prof Richards as the Sir Alan Cobham Research Fellow in Aeronautics. He became a lecturer in Aeronautics in the following year and helped to develop the structural dynamics research activity in the University. In 1963 he transferred to the newly formed Institute of Sound and Vibration Research. He was appointed Professor of Vibration Studies in 1966 and in the following year took over the Directorship of ISVR.

On the international scene, Prof Clarkson was Chairman of the Organising Committee of the 8th International Congress on Acoustics and was elected a member of the International Commission on Acoustics in 1972. In 1975 he became Secretary of

the ICA and he is now halfway through a second three-year term in that office.

In 1978 he became Dean of the Faculty of Engineering and Applied Science in the University of Southampton; in October he begins a four-year sentence as Deputy Vice-Chancellor. During these administrative tasks he is trying to keep up an active interest in structural dynamics and at the moment is engaged on a research project on spacecraft vibration sponsored by the European Space Agency.

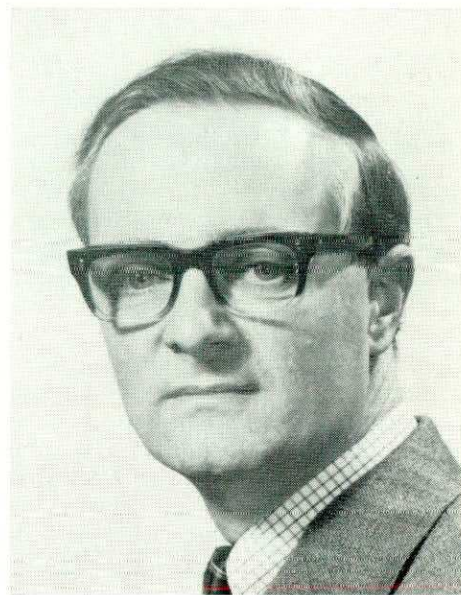
**President-Elect**  
**David Weston**



David Weston is a Deputy Chief Scientific Officer at Admiralty Underwater Weapons Establishment, and previously with Admiralty Research Laboratory. He joined the latter immediately on leaving the Imperial College of Science and Technology, but has also spent a year each at the Hudson Laboratories of Columbia University and the Applied Research Laboratories of the University of Texas at Austin. His principal professional interest has been in oceanographic acoustics, including sound propagation, underwater explosions as acoustic sources, the low frequency acoustic phenomena associated with

fish having swim bladders, and sonar generally. Earlier he was connected with the Acoustics Group of the Institute of Physics, and received the Silver Medal from the British Acoustical Society. At the Institute of Acoustics Dr Weston is now President-Elect, Chairman of the Publications Committee, and a past Chairman of the Underwater Acoustics Group.

**Vice-President**  
**Michael Delany**



Michael Delany graduated from Battersea Polytechnic and gained his PhD at Imperial College, London. He is now a Principal Scientific Officer at the National Physical Laboratory, where he has been since 1961. He is interested in many aspects of audio-frequency acoustics and has made contributions to electroacoustical development and standardisation, atmospheric sound propagation, acoustical properties of sound-absorbing materials, and the design and performance of free-field rooms. He is a member of three BSI Committees (representing the Institute of Acoustics on two of these) and serves as UK expert on four IEC Working Groups. He was an active member of the old Acoustics Group, serving as Joint Honorary Secretary for three years,



and was instrumental in the formation of the Institute of Acoustics in 1974. Since then he has served on Council, on the Meetings and Publications Committees, founded the Acoustics Bulletin which he edited for the first four years, and has been a Vice-President since 1976. Dr Delany was the recipient of the Institute's first Tyndal Medal in 1976.

**Vice-President**  
**David Johns**



David Johns graduated from Bristol University with an Honours degree in Aeronautical Engineering, as a sponsored student of the then Bristol Aeroplane Company Limited. His first graduate employment was with that company as an Aeroelastician working on Guided Missiles, notably Bloodhound. He later moved to Armstrong-Whitworth Aircraft Company Limited, continuing to work on Guided Weapons, as a Future Projects Officer. He worked on Sea-Slug and its later developments, and also on the early design stages of Sea-Dart. After joining the College of Aeronautics as a Lecturer in Guided Weapons, he subsequently transferred to a post as Lecturer in Aircraft Design, covering particularly aeroelastic and thermoelastic problems. At this time his research was primarily in these two areas. In 1964 he moved to Loughborough University of Technology as Reader in Aeronautics, and was promoted to a personal chair in 1968. He became Head of the Department of Transport Technology in 1972, the post he still holds, and he has also held the office of Dean of the School of Engineering at Loughborough. Apart from basic aeronautical research

topics, his interests have moved more widely into general fields of mechanical and civil engineering, particularly in the areas of structural vibration, buckling, stress analysis, etc. He has organised international Symposia on Wind Effects on Buildings and Structures, and this topic remains one of his current primary research interests. He is the author of the textbook, *Thermal Stress Analyses*, and co-author of another book concerned with Space Technology. Despite his strong affiliation with Aeronautics, Prof Johns believes that the Institute of Acoustics offers the best means for all those professionally engaged in Structural Vibration in all engineering disciplines to come together to share ideas and discuss research methods and he hopes to see this aspect of the Institute's activities grow.

**Vice-President**  
**Roy Lawrence**

On leaving St Albans Grammar School, Roy Lawrence worked as a laboratory assistant for two years with ICI Plastics Division at Welwyn Garden City. He was awarded a Plastics Institute bursary, leading to graduation in physics at the University of Liverpool. Then followed three years postgraduate study leading to a PhD for work on molecular sound absorption in polyatomic gases. This was followed by two years as a research physicist for ICI General Chemicals Division at Widnes working in mass spectrometry and electron microscopy.



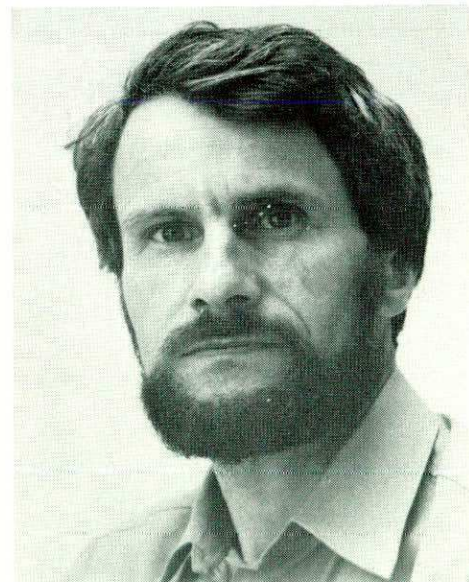
The years 1960-1963 were spent teaching physics at the Haile Selassie University in Addis Ababa. Upon returning to the UK, Dr Lawrence took up an appointment as a lecturer in physics

at Liverpool Polytechnic, where he established the Polytechnic's Acoustics Group in 1975 with activities mainly in the environmental noise field. His present position is Principal Lecturer in the department of physics.

His present research interests include modelling urban sound propagation and education; he is a former part-time member of the Nuffield supported Higher Education Learning Project and currently a member of the CNAA physics board.

Sometime Chairman, Hon Secretary and member of various Institute of Physics committees, Dr Lawrence is a member of the Publications and Medals and Awards Committees and the Acoustics and Noise Control Diploma Examination Board of the Institute of Acoustics, and is Chairman of the Meetings Committee, being the organiser of the Institute's 1975 Spring Conference at Liverpool and the 1979 Autumn Conference at Windermere.

**Secretary**  
**Frank Fahy**



After graduating from London University in Aeronautical Engineering, Frank Fahy spent five years in the Aircraft Research Association Limited, Bedford, working on the design and testing of aeroelastic wind tunnel models. In 1963 he joined the Institute of Sound and Vibration Research, Southampton University, as Research Fellow and was subsequently appointed CEBG Lecturer at the ISVR to form and lead a group researching into noise and vibration problems in nuclear reactors. He was awarded the degree of PhD for his work on acoustically excited vibration of structures. In 1975 he was appointed CEBG



Senior Lecturer in ISVR, and has also been engaged in teaching and research in Sweden, Norway and more recently in Brazil. His teaching subjects include engineering acoustics, building acoustics, fluid dynamics, mechanics and machinery noise.

Dr Fahy was Chairman of the IOA's Southern Branch from 1974 to 1979 and has been a member of the Diploma Examination Board and Honorary Secretary of the IOA since 1977.

#### **Treasurer**

##### **Geoff Leventhall**

Geoff Leventhall served for several years on the Meetings Committees of both the British Acoustical Society and the Institute before being elected to Council in 1975. He has organised a number of major Meetings for the Institute, including 'Acoustics 80' and became Treasurer in 1979. As Reader in Acoustics at Chelsea College, University of London, he leads the Applied Acoustics Group and is responsible for post-graduate courses and research in acoustics. During his 20 years at Chelsea, about 125 MSc and PhD students have studied in the



Group, most of them in the past 12 years; the award of the Institute's Tyndall Medal in 1978 was for services to acoustics education. His main research areas are now in low frequency noise and active attenuators for noise, whilst other interests include acoustical consultancy and editorial work on acoustics journals.

he acted as acoustic consultant for the design of the very successful Turner Sims Concert Hall at Southampton University.

Professor Doak has played a major role in the growth of the undergraduate course in Acoustical Engineering at Southampton University and has been actively involved in many new developments in undergraduate engineering studies.

He is the founder and very active editor of the *Journal of Sound and Vibration* (1963). In a relatively short period of time this journal has reached a very high standard and gained international recognition as one of the major journals of acoustics. By his open-minded editorial policy he has encouraged publication by many able, but inexperienced, researchers, not favouring the esoteric in preference to the more practically oriented contributions.

Throughout all this work he has striven to maintain very high academic standards and through his example he has encouraged many others to find challenging careers in acoustics.

#### **Biographical Note**

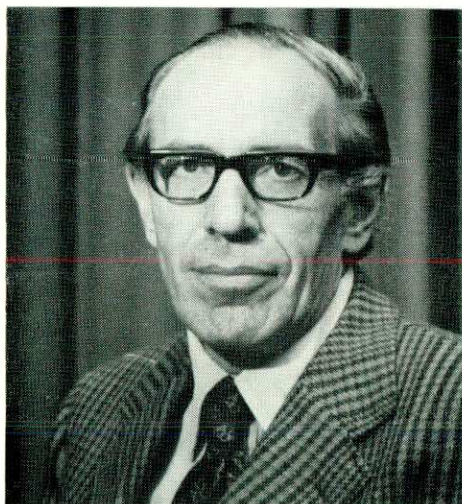
Professor Doak was born in North Dakota in the United States of America and studied initially at the University of North Dakota. From there he moved to the Institute of Musical Art of the Julliard School of Music, New York City from which he graduated in Piano in 1942. Following service in the US Army Signal Corps during the war he undertook studies in Physics at the University of Oklahoma from which he graduated with BA and MS degrees. He then carried out research in the Acoustics Laboratory of the Massachusetts Institute of Technology, in the company of many household names in acoustics, and made significant contributions to the statistical analysis of sound fields in enclosures and their subjective effects. Leaving his native America he spent three years in the Department of Mathematics of Manchester University, followed by four years in the Mechanics of Fluids Laboratory there. In 1958 he was appointed Lecturer in Applied Mathematics at Liverpool University. A move south brought him to Southampton University, where, after a brief spell in the Department of Aeronautics, he joined the newly formed Institute of Sound and Vibration Research in which he has held the posts of Hawker Siddeley Lecturer, Reader and, since 1970, Professor of Acoustics. □

## **CITATION — Rayleigh Medal 1980**

### **Professor Philip Ellis Doak**

The 1980 Rayleigh Medal is awarded to Professor Philip Doak in recognition of the major contributions which he has made to the advancement of the science and the art of acoustics. In addition to his direct contributions he has helped other to communicate the results of their work through the *Journal of Sound and Vibration*.

Early in his career he published important work on the newly developing subject of statistical analysis of sound fields in enclosures, and also on their subjective effects. After his move to England from his native America he concentrated upon theoretical analysis of unsteady motion of compressible fluids, and laid the foundations of his later publication of a unified theory of aerodynamically generated sound. This theory applies to generation by jets and boundary layer and flow within ducts, and allows inclusion of temperature and density gradients and wall characteristics. In collaboration with industry he has developed theoretical analyses of sound propagation in, and radiation from, flow ducts, and has



aided the development of test facilities.

Through his supervision of postgraduate students he has made significant contributions to theoretical and experimental analyses of propagation, absorption, and scattering of sound fields, subjective and physical aspects of musical sounds and instruments, and very importantly, to the improvement of understanding of the relationship between the physical behaviour and the subjective effects of sound fields in auditoria. In this connection



# Acousto-Optics and its Applications

The First Spring School on Acousto-Optics and its Applications was held on 26 — 30 May 1980 at one of the Polish Leisure Centres, at Wiezyca, about 50 km from Gdansk. The meeting was organised by Prof A Slivinski, a leading world worker in this field, who had gathered together a number of distinguished researchers from many countries; in all there were 80 delegates. Only a single session operated throughout and with an allocation of 45 minutes per lecture plus 15 minutes discussion and a liberal lunch break the setting was complete for a highly useful and informal meeting. Additionally those contributors not included in the lecture programme were able to discuss their work in poster sessions.

Amongst the main contributors was Prof R Mertens from the Institute of Theoretical Mechanics at Ghent, Belgium, whose theoretical work in Acousto-Optics has formed the basis for many experimental investigations and in particular for recent results obtained at Gdansk in Prof Slivinski's laboratory which he described at one of his lectures at the meeting. In his second lecture Prof Slivinski spoke on

*Optical Holography and Acousto-Optics* and an informative contribution by Dr J Somer (University of Limburg, Netherlands) was entitled *Application of an Optical Deconvulser for Blurred Ultrasound-Diagnostic Images*.

Bragg diffraction of light by ultrasound as a specific tool for solid state investigations formed the subject of Prof Zarembowitch's (University of Paris) lecture while Prof Breazeale (University of Tennessee, USA) was concerned with Bragg imaging of finite amplitude ultrasonic radiation. Of the other topics a paper of some interest was that on the application of double exposure holography to intensity measurements of arbitrarily-shaped ultrasonic fields, the author being Dr R Reibold of the Physikalisch-Technische Bundesanstalt, Braunschweig, FRG. M Szustakowski of the Military Technical Academy of Warsaw gave a very comprehensive talk on the acousto-optical devices of signal processing. Other contributions of a theoretical nature were given by Prof Gabrielli (University of Trieste, Italy) on *Spatial and Temporal Light Modulation by Ultra-sound* and by Prof Malecki of the Polish Academy of

Sciences who spoke on ultrasonic propagation in non-homogeneous media such as piezo-electric ceramics. A useful contribution on the study of SAW propagation velocity in layered media was presented by A Defebore (Free Faculty of Sciences, Lille, France) while Dr Zieniuk with J Litrowski, (Fundamental Technological Research Institute of Warsaw) spoke on the influence of coherence and wavelength on ultrasonic images. The photoacoustic effect with some applications was the subject of an invited talk by the writer. The concluding session was devoted to biological aspects. Prof Pimonow (CNRS, Paris) spoke on *Intercellular Information and Ultrasonics*, while the title of Dr Watmough's (University of Aberdeen) lecture concerned an investigation by tele-microscopy and electron microscopy of the biological effects of ultrasound with a view to damaging malignant tumours.

The organisers of the meeting are to be congratulated on arranging such a pleasing background to the meeting from the aspects both of the surrounding environment and the conduct of the proceedings. □

R W B Stephens

## ACOUSTICS LETTERS

**...for people who read and  
write about acoustics...**

ACOUSTICS LETTERS 14 BROADWAY LONDON SW1H 0BH ENGLAND

## Acoustics Bulletin

One of the leading publications in its field, Acoustics Bulletin provides an important key readership representing the major interests in the rapidly growing acoustics market.

### ADVERTISEMENT RATES

|              |      |
|--------------|------|
| Full page    | £120 |
| Half page    | £70  |
| Quarter page | £40  |

Rates for special positions, colour, series etc on request.

Letterpress, blocks screen 47.

Publication dates: January, April, July, October.

Copy deadline: 1st of preceding month.

Enquiries to: **H A COLLINS LTD**  
37 Ruskin Road  
Carshalton  
Surrey SM5 3BQ  
Telephone: 01-647 1393

# Report of the Auditors to the Members of The Institute of Acoustics Limited

*We have examined the Accounts set out on Pages 27 to 29. These have been prepared under the Accounting Policies stated on Pages 28 and 29.*

*In our opinion these Accounts give a true and fair view of the state of the Company's affairs as at 31st December, 1979 and of its Loss and Source and Application of Funds for the year ended on that date and comply with the Companies Acts 1948 and 1967.*

*Knox Cropper, Chartered Accountants  
26th February, 1980*

*16 New Bridge Street,  
LONDON EC4V 6AX*

## THE INSTITUTE OF ACOUSTICS LIMITED

(A Company Limited by Guarantee and not Having a Share Capital)

### INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1979

| Income                                          | 1979   |  |          |  | 1978  |  |        |  |
|-------------------------------------------------|--------|--|----------|--|-------|--|--------|--|
|                                                 | £      |  | £        |  | £     |  | £      |  |
| Subscriptions — Current ... ..                  | 15,520 |  |          |  | 9,992 |  |        |  |
| — Arrears ... ..                                | 28     |  |          |  | 40    |  |        |  |
|                                                 |        |  | 15,548   |  |       |  | 10,032 |  |
| Meetings ... ..                                 |        |  | 2,066    |  |       |  | 4,247  |  |
| Publications — Acoustics Bulletin ... ..        | 858    |  |          |  | 1,721 |  |        |  |
| — Proceedings ... ..                            | 206    |  |          |  | —     |  |        |  |
| — FASE Symposium ... ..                         | 20     |  |          |  | 1,953 |  |        |  |
|                                                 |        |  | 1,084    |  |       |  | 3,674  |  |
| Deposit Interest ... ..                         |        |  | 710      |  |       |  | 325    |  |
| Sundry Income ... ..                            |        |  | 25       |  |       |  | 34     |  |
|                                                 |        |  | 19,433   |  |       |  | 18,312 |  |
| <b>Deduct: Expenditure</b>                      |        |  |          |  |       |  |        |  |
| Administrative Charge ... ..                    | 6,922  |  |          |  | 7,000 |  |        |  |
| Printing, Stationery and Duplicating ... ..     | 3,357  |  |          |  | 1,125 |  |        |  |
| Postage ... ..                                  | 1,469  |  |          |  | 1,623 |  |        |  |
| Publications — Acoustics Bulletin ... ..        | 6,544  |  |          |  | 4,330 |  |        |  |
| — Proceedings ... ..                            | 6,963  |  |          |  | 3,005 |  |        |  |
| — General ... ..                                | 182    |  |          |  | 112   |  |        |  |
| Committee Travel Expenses ... ..                | 790    |  |          |  | 912   |  |        |  |
| Officers' Expenses ... ..                       | 450    |  |          |  | 237   |  |        |  |
| Medals and Awards ... ..                        | 9      |  |          |  | 67    |  |        |  |
| Telephone ... ..                                | 234    |  |          |  | —     |  |        |  |
| Removal Expenses ... ..                         | 143    |  |          |  | —     |  |        |  |
| Filing Organisation ... ..                      | 195    |  |          |  | —     |  |        |  |
| Bank Charges ... ..                             | 25     |  |          |  | 32    |  |        |  |
| Audit and Accountancy ... ..                    | 475    |  |          |  | 75    |  |        |  |
| Depreciation — Medal Dies ... ..                | 121    |  |          |  | 121   |  |        |  |
| — Office Equipment ... ..                       | 55     |  |          |  | —     |  |        |  |
| Staff and Sundry Expenses ... ..                | 214    |  |          |  | 409   |  |        |  |
|                                                 |        |  | 28,148   |  |       |  | 19,048 |  |
| <b>Excess of Expenditure over Income ... ..</b> |        |  | £(8,715) |  |       |  | £(736) |  |



**THE INSTITUTE OF ACOUSTICS LIMITED**  
**(A Company Limited by Guarantee and not Having a Share Capital)**  
**BALANCE SHEET**  
**AS AT 31st DECEMBER, 1979**

|                                              |  |  |  |  |  | 1979       |                  | 1978     |        |
|----------------------------------------------|--|--|--|--|--|------------|------------------|----------|--------|
|                                              |  |  |  |  |  | Medal Dies | Office Equipment | Total    |        |
|                                              |  |  |  |  |  | £          | £                | £        | £      |
| <b>Fixed Assets</b>                          |  |  |  |  |  |            |                  |          |        |
| Cost at 1.1.79                               |  |  |  |  |  | 725        | —                | 725      | 725    |
| Additions                                    |  |  |  |  |  | —          | 550              | 550      | —      |
|                                              |  |  |  |  |  | 725        | 550              | 1,275    | 725    |
| Depreciation                                 |  |  |  |  |  | 604        | 55               | 659      | 483    |
|                                              |  |  |  |  |  | £121       | £495             | 616      | 242    |
| <b>A B Wood Memorial Fund Account</b>        |  |  |  |  |  |            |                  | 719      | 646    |
| <b>Current Assets</b>                        |  |  |  |  |  |            |                  |          |        |
| Stationery Stock                             |  |  |  |  |  |            | 600              |          | 1,269  |
| Debtors and Prepayments                      |  |  |  |  |  |            | 2,479            |          | 2,979  |
| Cash at Bank                                 |  |  |  |  |  |            | 15,479           |          | 7,328  |
|                                              |  |  |  |  |  |            | 18,558           |          | 11,576 |
| <b>Less: Current Liabilities</b>             |  |  |  |  |  |            |                  |          |        |
| Trade Creditors and Accruals                 |  |  |  |  |  |            | 11,239           |          | 2,803  |
| Subscriptions in Advance                     |  |  |  |  |  |            | 7,610            |          | 6      |
| Institute of Physics                         |  |  |  |  |  |            | 978              |          | 2,744  |
|                                              |  |  |  |  |  |            | 19,827           |          | 5,553  |
|                                              |  |  |  |  |  |            |                  | (1,269)  | 6,023  |
| <b>Total Net Assets</b>                      |  |  |  |  |  |            |                  | 66       | 6,911  |
| <b>Less: Branch Subventions (Note 2)</b>     |  |  |  |  |  |            |                  | 6,863    | 5,066  |
|                                              |  |  |  |  |  |            |                  | £(6,797) | £1,845 |
| <b>Represented by:</b>                       |  |  |  |  |  |            |                  |          |        |
| <b>Capital Account</b>                       |  |  |  |  |  |            |                  |          |        |
| Balance as at 1.1.79                         |  |  |  |  |  |            | 1,199            |          | 1,935  |
| Transfer from Income and Expenditure Account |  |  |  |  |  |            | (8,715)          |          | (736)  |
|                                              |  |  |  |  |  |            |                  | (7,516)  | 1,199  |
| <b>A B Wood Memorial Fund</b>                |  |  |  |  |  |            |                  | 719      | 646    |
|                                              |  |  |  |  |  |            |                  | £(6,797) | £1,845 |

**THE INSTITUTE OF ACOUSTICS LIMITED**  
**(A Company Limited by Guarantee and not Having a Share Capital)**  
**NOTES TO ACCOUNTS**  
**FOR THE YEAR ENDED 31st DECEMBER, 1979**

**(1) ACCOUNTING POLICIES**

**(a) Basis of Accounting**

The Institute prepares its Accounts under the Historical Cost Convention.

**(b) Stocks**

Stationery Stock is stated at Cost.

**(c) Depreciation**

Medal Dies are written off over a period of six years and Office Equipment over ten years on a Straight Line Method.

**(d) Fees from Branches**

Fees received from Branches are credited to individual Branch Accounts and they are carried forward.

| (2) BRANCH SUBVENTIONS                         |  |  |  |  |  | 1979          | 1978          |
|------------------------------------------------|--|--|--|--|--|---------------|---------------|
| <b>Credit Balances</b>                         |  |  |  |  |  | £             | £             |
| General Accounts — NE Branch ... ..            |  |  |  |  |  | 215           | 148           |
| — Southern Branch ... ..                       |  |  |  |  |  | 120           | 88            |
| Groups — Aerodynamic Noise ... ..              |  |  |  |  |  | 591           | 495           |
| — Underwater Acoustics ... ..                  |  |  |  |  |  | 3,460         | 2,284         |
| — Music ... ..                                 |  |  |  |  |  | 134           | 47            |
| — Industrial Noise ... ..                      |  |  |  |  |  | 666           | 363           |
| — Speech ... ..                                |  |  |  |  |  | 154           | 61            |
| — Building Acoustics ... ..                    |  |  |  |  |  | 598           | 320           |
| Meetings — Main Holding Account ... ..         |  |  |  |  |  | —             | 789           |
| — Low Frequency Sound ... ..                   |  |  |  |  |  | —             | 350           |
| Diploma in Acoustics and Noise Control ... ..  |  |  |  |  |  | 1,100         | 340           |
|                                                |  |  |  |  |  | <u>7,038</u>  | <u>5,285</u>  |
| <b>Less: Debit Balances</b>                    |  |  |  |  |  |               |               |
| General Accounts — Main Holding Account ... .. |  |  |  |  |  | 73            | 73            |
| Groups — Main Holding Account ... ..           |  |  |  |  |  | 3             | 3             |
| — Physical Acoustics ... ..                    |  |  |  |  |  | 99            | 143           |
|                                                |  |  |  |  |  | <u>175</u>    | <u>219</u>    |
|                                                |  |  |  |  |  | <u>£6,863</u> | <u>£5,066</u> |

**THE INSTITUTE OF ACOUSTICS LIMITED**  
**(A Company Limited by Guarantee and not Having a Share Capital)**  
**STATEMENT OF SOURCE AND APPLICATION OF FUNDS**  
**FOR THE YEAR ENDED 31st DECEMBER, 1979**

| <b>SOURCE OF FUNDS</b>                           |  |  |  |  |  | <b>1979</b> |                 | <b>1978</b> |              |
|--------------------------------------------------|--|--|--|--|--|-------------|-----------------|-------------|--------------|
|                                                  |  |  |  |  |  | £           | £               | £           | £            |
| Loss for the Year ... ..                         |  |  |  |  |  |             | (8,715)         |             | (736)        |
| LESS: Items not involving the movement of Funds: |  |  |  |  |  |             |                 |             |              |
| Depreciation ... ..                              |  |  |  |  |  |             | 176             |             | 121          |
| <b>Total Absorbed by Operations</b>              |  |  |  |  |  |             | <u>(8,539)</u>  |             | <u>(615)</u> |
| <b>Funds from Other Sources</b>                  |  |  |  |  |  |             |                 |             |              |
| A B Wood Memorial Fund ... ..                    |  |  |  |  |  | 73          |                 | 34          |              |
| Branch Subventions ... ..                        |  |  |  |  |  | 1,797       |                 | 795         |              |
|                                                  |  |  |  |  |  | <u>—</u>    | <u>1,870</u>    | <u>—</u>    | <u>829</u>   |
|                                                  |  |  |  |  |  |             | <u>(6,669)</u>  |             | <u>214</u>   |
| <b>APPLICATION OF FUNDS</b>                      |  |  |  |  |  |             |                 |             |              |
| Purchase of Office Equipment ... ..              |  |  |  |  |  | 550         |                 | —           |              |
| A B Wood Memorial Fund Account ... ..            |  |  |  |  |  | 73          |                 | 34          |              |
|                                                  |  |  |  |  |  | <u>—</u>    | <u>623</u>      | <u>—</u>    | <u>34</u>    |
|                                                  |  |  |  |  |  |             | <u>£(7,292)</u> |             | <u>£180</u>  |
| <b>Increase/(Decrease) in Working Capital</b>    |  |  |  |  |  |             |                 |             |              |
| Stationery Stock ... ..                          |  |  |  |  |  | (669)       |                 | 743         |              |
| Debtors and Prepayments ... ..                   |  |  |  |  |  | (500)       |                 | 685         |              |
| Trade Creditors and Accruals ... ..              |  |  |  |  |  | (8,436)     |                 | (1,443)     |              |
| Subscriptions in Advance ... ..                  |  |  |  |  |  | (7,604)     |                 | 59          |              |
| Institute of Physics ... ..                      |  |  |  |  |  | 1,766       |                 | (436)       |              |
|                                                  |  |  |  |  |  | <u>—</u>    | <u>(15,443)</u> | <u>—</u>    | <u>(392)</u> |
| Movement in Net Liquid Funds:                    |  |  |  |  |  |             |                 |             |              |
| Increase in Cash at Bank ... ..                  |  |  |  |  |  |             | 8,151           |             | 572          |
|                                                  |  |  |  |  |  |             | <u>£(7,292)</u> |             | <u>£180</u>  |



# Treasurer's Report

*As all members must know by now, the year ending 31 December 1979 was, financially, the worst one since the formation of the Institute. The Accounts are printed in this issue of the Bulletin and some interpretation may be helpful.*

**E**VEN THOUGH subscriptions were increased substantially during 1979 to bring in an additional £5,500 over 1978, our total income increased by only about £1,500. This smaller than expected increase was largely due to the fact that our income from meetings and publications dropped markedly. However, the sum of £2,066 for meetings surplus gives a false impression, since a further £2,000 surplus from the 1979 Spring Meeting was due to us, but not received until well into 1980. The delay arose because the host Institution handled all the registration and accounting for the meeting and there was a considerable delay in finalising accounts. This will be avoided in future by ensuring that registration and financial aspects of major meetings are dealt with by the Head Office, so that registration fees come directly to the Institute, and accumulate in our account rather than that of another organisation.

It also appears that about a further £1,270 should have been credited to the Meetings account instead of to one of the Groups, thus making the actual surplus for meetings held in 1979 nearly £4,500. However, this is an internal transfer and does not affect the overall finances of the Institute.

The poor showing on income from publications has been one of the causes of our financial difficulties, the publications policy, which the Institute adopted several years ago, having resulted in rapidly expanding publication costs associated, last year, with a falling income. It was impossible to maintain expenditure for the Bulletin and Proceedings at around £13,500 with only a very small income from these and it has been decided to limit the expenditure of the Publications Committee to £6,000 in 1980. This makes it impossible to send Conference Proceedings to all members, but the Proceedings are available for purchase by members at favourable cost and the abstracts of Conference papers which now appear in the Bulletin will enable members who did not attend a Conference to be kept informed of it. It is hoped that the £6,000 allocated to publications this year will enable four issues of the Bulletin to be produced.

Referring again to the Income and Expenditure Account, the administrative charge for 1979 was kept to £6,922 in two ways. Firstly, the move to Edinburgh half-way through the year meant that our commitment to the Institute of Physics was only £6,000 for the half year, plus postage, printing and other costs which normally came to about £1,000 a quarter. However, after the move to Edinburgh had taken place, certain matters came to light which made us feel that the services provided by the Institute of Physics had, in some aspects, not been up to the standard which we expected. Negotiations with the Institute of Physics resulted in the administrative charge of £3,000 for the second quarter of 1979 being waived. This has been a great help to us. We are grateful for the consideration shown to us by the Institute of Physics at a time when they themselves have financial problems. It should be noted that, if we had stayed with the Institute of Physics, the administration charge for 1979 would have been £12,000 together with additional costs of £4,000 - £5,000, whilst the basic administration charge for 1980 was projected as £16,000. It is now clear that if we had not moved from the Institute of Physics during 1979 and had not increased the 1979 membership fees retrospectively, we would have been faced with an addition of about £10,000 to the existing deficit for the year and would have been unable to continue a legitimate existence.

The move to Edinburgh did, of course, involve us in some expenses. These came to about £1,500, including purchase of filing cabinets from the Institute of Physics, other office equipment, computerisation of the membership records on the Heriot-Watt system, etc. These costs were one-off items for 1979 and we hope that we can settle into the Edinburgh Office for the foreseeable future. It will be noted from the Expenditure Account that we now pay telephone charges separately, whereas they were previously absorbed by the Institute of Physics. We now also have increased charges for audit and accountancy. Previously, the auditors were able to make us only a nominal charge as they dealt with

other accounts at the Institute of Physics.

The final figure in the Capital Account shows a deficit of £6,797. This is rather misleading since the Institute, as a whole, did not end the year in the red to this amount. It is money which we owe to ourselves! It was difficult to convince members of this during the AGM at the Spring Meeting, but the peculiar accounting system which has developed over the years shows the credit balance from the Institute's various activities as if it was owed by the Institute to outside organisations. This is the item under Branch Subventions. I feel, as Treasurer, that the accounts would be clearer if the practice of deducting Branch Subventions from our total nett assets was discontinued in future accounting. I think it would also be clearer if the Branch, Group and Diploma accounts were shown on an annual credit/debit basis rather than an accumulative basis.

As 1979 was such a disastrous year financially, there is obvious concern about how we are coping in 1980. At the time of writing (during May), we know what our situation was up to the end of April, when two-thirds of the year has yet to run. At the end of April we had a total of about £20,000 in our deposit and current accounts. Outstanding bills are about £5,000 for 'Acoustics 80' and about £1,250 for the Bulletin. Deducting these from our money in hand leaves us with £13,750 to cover the remainder of the year. However, we have not yet received our full income for this year. The receipts from members' subscriptions have been about £14,500, but 160 out of our total assumed membership of 936 have not yet paid. The delinquents will have their membership terminated if they have not paid up by the end of June. Assuming that they all pay, the potential subscription income from them may be about £3,000, depending on their membership grades, not known to me at the time of writing. In addition, there are subscriptions outstanding from Sponsor Members, potentially about £2,000. The final figure for this is not known as the method of payment by Sponsor Members now gives them the opportunity to increase their subscriptions above the minimum in accordance with the number of persons they have working in acoustics. It is expected that the larger organisations will contribute £200 to £300 each, whilst the smaller ones will pay the minimum subscription of £100. Thus, the outstanding

subscription income is about £5,000 but, looking on the pessimistic side, we may only receive about half of this, say £2,500. Our remaining income will be mainly from Conference surpluses. There are two more large Meetings to be held this year, together with smaller ones. The Meetings might reasonably be expected to produce a combined surplus of £2,500. This means that our anticipated income from subscriptions and Meetings could be £5,000 during the rest of this year. Adding this to the reserves of £13,750 gives £18,750. There are further possible sources of income which I am not taking into account. These include bank deposit interest, Diploma, Group and Branch surpluses, Bulletin advertising, etc. The total of these could be about £2,000 but it is difficult to estimate and will not be considered.

Our expenditure for the Head Office, telephone, postage, committee ex-

penses, etc for the remaining two-thirds of the year is likely to be up to £10,000, together with publications costs of £3,000 (mainly two issues of the Bulletin). This gives anticipated expenditure of £13,000 leaving reserves of possibly £5,750 at the end of the year. There is a lot of guess-work in this estimate, particularly in the unknown aspects of remaining subscription and Conference surpluses. We are very dependent for our continuing existence on the surplus from Conferences and are beginning to add to this by sales of Conference Proceedings, mostly sales abroad following publicity. It is important to develop this aspect and I look forward to the possibility of sales of about £1,000 a year in 1981, although there may be only a few hundred pounds in 1980.

The overall picture of our finances in 1980 shows that, if the imponderables work in our favour, we will end the

year with reserves not far short of those with which we ended 1979. We are therefore in sight of paying our way. I looked upon 1979 as a year of difficulties and dangers, although the full extent of these did not become apparent to me until after I had agreed to take over the job of Treasurer in April 1979! 1980 is a year of retrenchment and consolidation, during which we will finally shake out the dead wood amongst our members and learn what level of organisation we really are. 1981 should be a little easier, but only if members are prepared to accept an increase in subscriptions in line with inflation. We are now able to begin to put aside the very real fears which we had last summer about the continuation of the Institute and to look forward to growth and success, in both the scientific and financial sides of the Institute's activities. □

H G Leventhall

**T**HERE IS NOW a significant number of Environmental Health Officers in the Institute of Acoustics, many at corporate membership grade and with one Fellow being elected from the profession. The EHO is traditionally accused of being self-effacing and of being less than publicity conscious. This attitude is changing and the 'jack of all trades' approach to a job of almost unbelievable variety is becoming less common. Specialisation in the various fields which lie within the purview of the EHO is becoming commonplace, due in no small part to the demands being placed upon the profession not only to widen areas of involvement in environmental health monitoring and control but also to increase the depth of expertise of the individual officers concerned. Thus more EHOs are joining the ranks of practical acousticians.

There is a lot of misunderstanding about the work of this peculiar local government officer and it is probably appropriate to explain in broad terms the duties and responsibilities of the 'average' Environmental Health Department and the officers who have a wide range of powers, duties and responsibilities. Firstly, in common with all local government officials they have (with a few exceptions) no outright executive powers. Decisions are made by locally elected representatives who form the Council, which for environmental, as opposed to 'personal', health functions is the Council of a District

## Noise Control and the Environmental Health Officer

*In this issue of the Bulletin, as a change from the 'Acoustics at ...' series, we have an article which describes the important role of the Environmental Health Officer in Noise Control. The article has been prepared by Mike Ankers of the City of Manchester Environmental Health Department.*

or London Borough. Thus decisions, although in many cases politically non-contentious, ultimately always require the confirmation of the Council.

The primary task of the local (and central) government officer is to advise the elected representatives on matters which fall within the defined remit of each separate department, liaising where necessary through a management team comprising the chief officers. The EHO's duties cover such diverse areas as inspection of meat and other foodstuffs, houses, licensed premises, massage parlours, swimming pools, cafés, hotels, animal boarding establishments, offices, factories . . . , the list is almost endless and continues to increase. Air pollution and noise are two main and expanding areas of involvement, along with matters relating to health and safety in certain workplaces.

In terms of noise control alone, there are few specific duties placed upon local authorities by the Control of Pollution Act, 1974, which, on becoming

operative on 1 January 1976, superseded the old Noise Abatement Act, 1960, and became the principal weapon in the armoury of noise control legislation which is used by the EHO. However, most local authorities have adopted policies and practices relating to noise control which substantially increase the workload of the officers beyond those duties.

At this point, it is important to recognise that the allocation of resources is determined politically; on the basis of what the priorities of the individual Councils are, manpower and financial resources are allocated in order that policy objectives may be achieved. It is entirely reasonable, therefore, that a local authority having few noise problems would not be able to devote significant amounts of time or money to the setting up of a specialist noise control section which would have but a small workload.

This is a factor which largely accounts for the wide variety of approach adopted by local authorities throughout the United Kingdom to the ques-



tion of environmental noise control. Most of the comments which follow are, therefore, only to be taken as typical of a large local authority, such as the City of Manchester (with a population of around 0.5 million people) although it is also true that many smaller authorities have acquired a high level of expertise and a substantial amount of sophisticated equipment, and often have specific problems which require the full employment of these resources.

The primary duty is to deal with noise which is a nuisance by the service of notice. What constitutes a nuisance within the meaning of the Act is very complex and difficult to define and is beyond the scope of this short article. It is enough to say that a 'nuisance' at law is some physical factor to which the ordinary 'average' person would reasonably object, and judgements of nuisance are made on this subjective basis. Any abatement notice resulting from the identification of a noise nuisance does not have to specify the works which are necessary for the satisfactory abatement of the nuisance but often, for the avoidance of doubt and the guidance of the person on whom the notice is served, works or other remedial steps may be detailed. This is usually fairly easy to do — switch off, limit hours of operation, provide simple enclosures, splitter silencers etc, but on occasion the definition of an appropriate remedy (complicated by the availability of a 'best practicable means' defence which includes financial considerations) may be beyond the capability of the department and an acoustical consultant

may be called in to advise either party, or both.

Although the number of complaints received is not now regarded as an entirely adequate indicator of the overall level of dissatisfaction shown by a population exposed to noise from a wide range of sources, most local authorities continue to amass large amounts of statistical information, including levels of complaint. Figure 1 shows the rise in level of complaint by source of noise in England and Wales since 1971. The figures are based on the returns made to the Association of Environmental Health Officers over the period shown but 'corrected' on the basis of a notional 100% return. It should be noted that returns for 1974, during the year of local government re-organisation, I considered to be statistically invalid and not susceptible to such normalisation.

The cumulative totals for a longer period, shown in Figure 2, are compared with other data on resultant action, most interesting of which is the comparatively low level of formal proceedings instituted. This is regarded as an indicator of the high level of co-operation usually to be found between local authorities and ratepayers of all descriptions, which results in the achievement of a satisfactory conclusion without wholesale resort to the punitive powers which are nevertheless available. It is even more interesting to note that under 100 prosecutions were undertaken in 1978 as a result of failure to comply with a notice served under the terms of Section 58 of the Act.

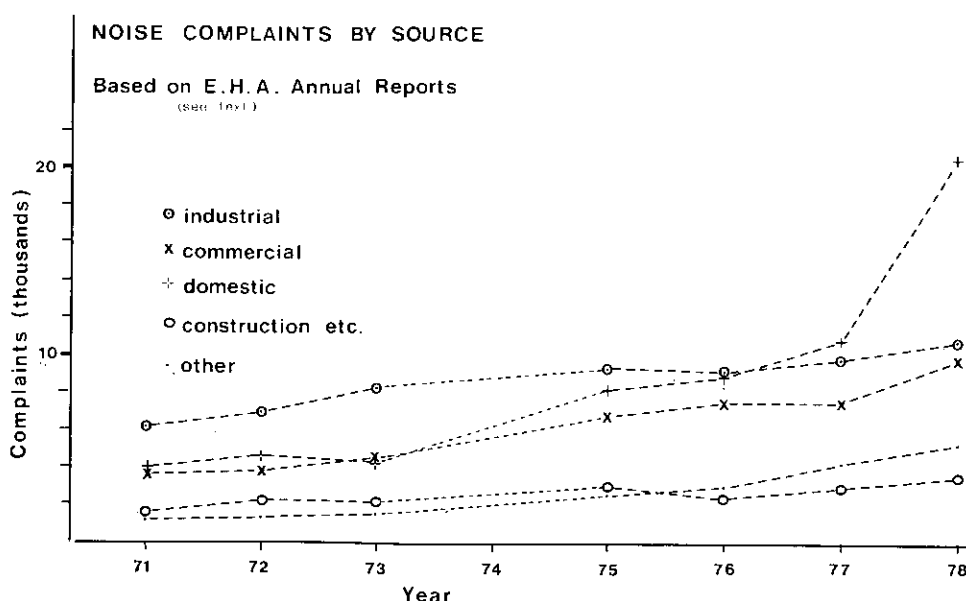


Fig.1

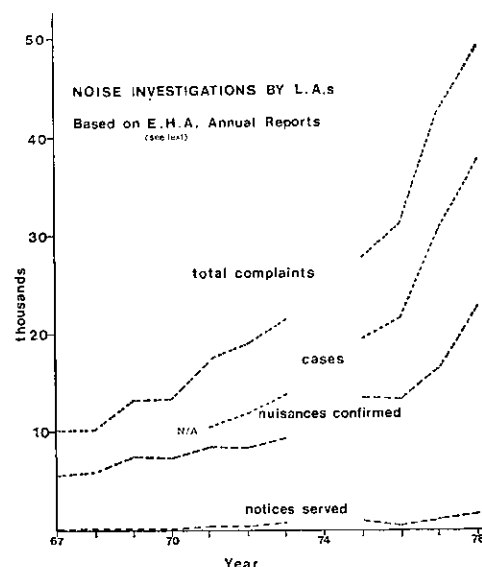


Fig.2

Figure 3 is based on records kept within the Environmental Health Department of the City of Manchester and introduces an additional important factor — the number of visits made by EHOs to premises on noise matters. It is clearly seen that more than one visit per complaint is made and the proportional levels are increasing. This is an indication of the increased degree of complexity involved in investigation and the resources which this authority in particular is prepared to invest in the field of noise control.

Over the past decade, Manchester has developed a specialist noise section within the Department which now has three well-qualified staff engaged full-time on noise control duties and which has available to it over £25,000 worth of equipment, including a mobile noise measurement laboratory. Just over half of the visits are however made by the general district EHOs, whose task it is to deal with the accelerating numbers of complaints from residential occupiers concerned about noise from domestic property and licensed premises — excessively loud amplifiers, barking dogs etc, and who seek advice on and are helped with measurements in the more difficult situations.

The specialist section is becoming increasingly involved in non-complaint related situations such as noise surveys for land use planning purposes, acoustic measurement and advisory services for other departments of the City Council and the determination of applications for prior consent for the carrying out of potentially noisy works of construction or demolition. The creation of a pilot Noise Abatement

Zone is also under consideration and a service is being provided to the Council's Safety Officer for the evaluation of hearing damage risk in local authority establishments.

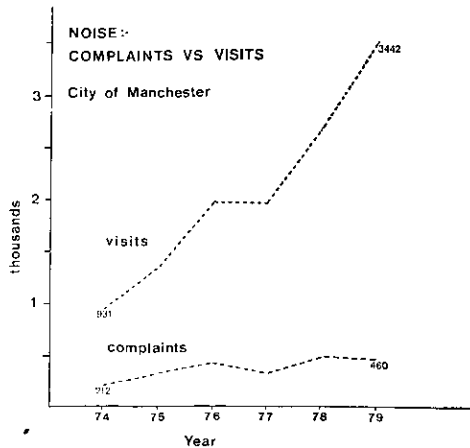


Fig. 3

It is to these areas, where techniques, founded upon expertise, experience and the reliable acoustic data which results from long-term on-site surveys, that emphasis is being applied. The potential for ensuring that undesirable noise sources are not introduced into already sensitive areas, or for preventing the building of conventional housing types adjacent to existing noisy areas through land use planning controls is a nettle that is becoming more firmly grasped by the EHO and his Planning Officer colleagues. The accent is being placed on prevention rather than cure, although there will always be a place for powers to permit remedial control of nuisance situations. Thus the Environmental Health Officer is responding to the need for a greater and better degree of environmental control. Whilst complaints continue to increase, this is not necessarily indicative of a worsening of noise climates generally but probably reflects a growing public noise-awareness and greater level of environmental expectancy.

The introduction of the Diploma in Acoustics has provided the EHO in particular with a method of increasing his expertise in an area where his/her base training and education may have been lacking. The opportunity presented by this route to gain Corporate Membership is welcomed and it is hoped that an increased involvement by the EHO in the field of practical applied acoustics will be of benefit both to the individual and to the Institute of Acoustics. □

M S Ankers

# Traffic Noise in Perspective

*In a summary of his invited lecture given at Acoustics '80, R L Wilson of RTM Planning Partnership reviews the way in which noise problems have increasingly been taken into consideration in the road planning process.*

**M**ANY PEOPLE think that the motorway is a continental invention and yet in the dusty records of Westminster are Parliamentary Bills for several 'Motor Ways' which were proposed at the end of the Nineteenth Century, but which were defeated by those representing the interests of railways. The Motor Way Bills are each set out as a Railway Bill with details of cost and land take: the London and Brighton Motor Way was proposed in 1906 as a 'double way' toll road for 'vehicles propelled by either petrol, alcohol, gasoline, steam or electricity or any other mechanical or chemical power'; horse-drawn vehicles, animals and pedestrians were excluded. The estimated cost of the 40 miles of the Brighton motorway in 1906 was £1.6 million: there was no mention of the effect of traffic noise.

When the UK motorway programme started in earnest in the 1950s, schemes were again promoted on the basis of cost and land take only: the 'direct effect' on housing — involving acquisition of land or demolition — was important but if no land was taken no compensation was payable, no matter how close the new road came to a dwelling. In the early 1960s methods were devised to calculate the savings in travel and accident costs — travel benefits — and the first economic assessments compared the first year travel benefits with the capital cost (first year rate of return). Little account was taken of the effect of the construction of the new road on the environment of those left living alongside the route.

In the early 1960s the environmental effect of motorways was recognised by a count of houses left within 60 ft of a fenceline, whether or not part of the garden was taken. In 1964 alternative routes for the M23 London-Crawley Motorway were compared on the basis of:

Cost  
Houses — demolished  
— remaining within 60 ft of fenceline

First year travel benefits

In 1970 the Urban Motorways Committee separately identified the main environmental nuisances, as seen by those left after the construction of a new road, as:

Nuisances during construction  
Severance  
Visual annoyance  
Traffic noise

Approximately 50% of those surveyed did not volunteer any problems caused by the new road. Of those that were caused annoyance, traffic noise was the greatest nuisance to those living within 60 metres of the new road, but the incidence of severance as a major nuisance was not distance related. 48% of those responding considered the construction time to be the most annoying period.

One of the studies for the Urban Motorway Committee attempted to put a value on every nuisance: the various costs and benefits and groups of people bearing them were identified in a cost/benefit analysis which expressed the worth of a scheme in a single aggregated value. The method was an interesting decision tool but was not comprehended by the public and probably represented the furthest swing towards numeracy in planning of highways.

Following the Report of the Urban Motorways Committee, environmental nuisances to those indirectly affected by highway construction were recognised in the Land Compensation Act 1973. The Act requires the Highway Authority to provide noise insulation — usually double glazing and a ventilation system — for certain properties affected by road traffic noise. The regulations governing the installation of noise insulation state three basic conditions which must be satisfied:

- (i) the noise level must be greater than 67.5 dB(A),
- (ii) there must be an increase of at least 1 dB(A) over the existing noise level,
- (iii) the new road should contribute at least 1 dB(A) to the final noise level.



The regulations require traffic noise to be expressed as 18-hour  $L_{10}$  noise levels, that is the noise level exceeded for 10 per cent of the time measured for a few minutes every hour and averaged over the period from 6 am to midnight.

The properties to which this applies must:

- (i) be a dwelling or building used for residential purposes,
- (ii) be within 300 m of a new or altered highway,
- (iii) not be subject to compulsory purchase or demolition order, or be within a clearance area,
- (iv) be a building not already receiving a grant for noise insulation work.

Under Part 1 of the Land Compensation Act, a householder can receive compensation if he can demonstrate that 12 months after the new road is opened, the value of his property has fallen due to physical factors resulting from the scheme. The value of this payment is assessed by the District Valuers and the change in noise climate is an important factor in the assessment.

The annoyance caused during construction was recognised in the Control of Pollution Act 1974 which gives the Local Authority the power to control the noise emission from construction and demolition sites. The Local Authority can specify:

- (i) the plant or machinery which is or is not to be used,
- (ii) the hours during which the works may be carried out,
- (iii) the levels of noise which may be emitted during specified hours.

For construction noise the  $L_{eq}$  is used: a typical maximum level is 75 dB(A)  $L_{eq}$  over a 12-hour period 7 am to 7 pm. The Highway Authority may in any event undertake noise insulation of properties badly affected by construction noise.

Apart from being essential for the determination of formal compensation for environmental nuisance, the measurement and prediction of traffic noise has become important in the assessment of alternative routes for new roads. An assessment for the A55 North Wales Road in 1971 was based on:

Cost  
Net Present Value  
Loss of Property

## Noise Visual Intrusion

Estimates were made of the number of houses which after the construction of the new road would be left within three noise climates:

greater than 75 dB(A)  
50 to 75 dB(A)  
less than 50 dB(A)

By 1974 evidence at the Public Inquiry into the new A55 was being given on a far wider and more comprehensive basis: the aspects or effects examined included: Alignment; Construction; Traffic on New Route; Traffic left on existing network; Economic Assessment; Social Costs; Industry and Commerce; Education; Recreational Facilities; Built Environment; Rural Environment; Ecology; and Planning.

Noise was dealt with generally under Construction and more specifically under the effect on the Built Environment where the number of houses affected by a change in noise climate due to the new road was estimated in the following categories:

Significant increase — 5 to 10 dB(A);  
Substantial increase — 11 to 20 dB(A);  
Severe increase — greater than 20 dB(A); also Decrease greater than 5 dB(A)

Estimates were also made of the number of houses which might be eligible for noise insulation under the Land Compensation Act.

During the late 1970s a consensus emerged that there was no right answer to the route, or even the need, for a new highway; the importance of identifying the separate effects of alternative routes without aggregation was recognised, as was the need at the end of the day for a value judgement to be made. In 1976 a committee under the chairmanship of Sir George Leitch was set up to review the Department of Transport's methods of appraising trunk road schemes and of forecasting traffic. Two important recommendations of the committee's report in October 1977 were

- (i) the assessment should be generally comprehensible to the public and command their respect;
- (ii) the public should be able to identify how different groups of individuals would be affected by the scheme.

Following the Leitch Committee's report, the Government set up a Standing

Advisory Committee on Trunk Road Assessment (SACTRA). In a report dated October 1979 (published February 1980) the Committee set out the elements of an assessment framework in which the effect of new roads on the following 'groups' was identified:

Travellers  
Occupiers  
Users of Facilities  
Policies for conserving and enhancing the area  
Transport, Development and Economic Policies  
Financial Implications

In this latest assessment the effect of traffic noise is not dealt with as an entity but considered as an element of the effect on each group; for example, the change in noise climate outside houses and industrial premises is an effect on sub-groups of 'Occupiers'. The change in noise climate inside public buildings, theatres, libraries, churches, etc, is an effect on sub-groups of Users of Facilities. The accuracy of any noise estimate becomes more precise as the route study progresses from the public consultation stage to public enquiry. At public consultation the SACTRA report suggests that properties within 300 m of each route are a sufficient proxy for traffic noise. (Using the computer, however it is now possible to estimate quickly the change in noise climate for each individual property even at this preliminary stage.) At the public inquiry, SACTRA advises that houses experiencing a change in noise climate are put into three categories:

increase/decrease 5 to 10 dB(A)  
10 to 15 dB(A)  
more than 15 dB(A)

Consideration of traffic noise is a small but important brick in the assessment of highway schemes. In making comparisons between alternative routes, it is more important to use the same method of measurement and forecasting of the change in noise climate for each route than to achieve a high accuracy in each forecast; those making decisions have to be reminded that not everyone is perturbed by noise, as is often demonstrated by new development alongside motorways. On the other hand, forecasts of traffic noise on which statutory compensation is based have to be done exactly in accord with the regulations; they are a means to an end and neither the realism of the forecast nor the sensitivity of the person affected by noise are factors. □

R L Wilson

# International INCE

## The International Institute of Noise Control Engineering-Aims and Methods

*The Institute of Acoustics was recently elected a member of International INCE. Professor Fritz Ingerslev, President of I/INCE, describes its origins and constitution, its aims and activities.*

### The Noise Problem

**N**OISE is a problem felt by millions of individuals in such forms as impaired hearing, annoyance, intrusion of privacy and sleeplessness.

Noise is an insidious poison. Repeated exposure to noise day after day through many years may be a threat to our health. Noise is therefore a vital factor in our life. We must provide an environment free from noise that jeopardises the public health or welfare.

It is obvious that noise control is a tremendous, world-wide task.

### International Co-operation: ICA — ISO — IEC — I/INCE

Acoustics was, up to the first decades of this century, a section under physics. The increasing interest during the first half of this century in pure and applied acoustics resulted in the establishment of acoustics as an independent discipline. Acoustics rapidly developed to become an important interdisciplinary activity — perhaps to a greater extent than has been the case with any other engineering discipline.

International co-operation through the exchange of knowledge, experience and views can promote acoustics in general and noise control in particular. This was realised some 30 years ago.

International co-operation in acoustic research was established in 1951 by the creation of the International Commission on Acoustics (ICA). ICA is a 'special commission' of the International Union of Pure and Applied Physics (IUPAP). The purpose of ICA is to promote and foster international collaboration in pure and applied acoustics.

International co-operation in standardisation in the field of acoustics began immediately after World War II. The work was undertaken by Technical Committee 43 of the International Organisation for Standardisation (ISO)

and Technical Committee 29 of the International Electrotechnical Commission (IEC).

The great interest in noise control which was provoked through the demand for favourable conditions resulted in a pronounced need for extension of the already established international co-operation. It was realised that an organisation which could undertake the international leadership in applying noise control technology should be established. INCE/USA encouraged the formation of an International Institute of Noise Control Engineering. The Institute was established in October 1974 by the general chairmen and other organisers of INTER-NOISE 1972 and 1973.

### The International Institute of Noise Control Engineering (I/INCE)

The Institute is a non-profit organisation.

The purposes of I/INCE comprise:

- a) the organisation of international conferences;
- b) the international exchange of information and news items;
- c) the promotion of international co-operation in research on noise control and the application of engineering techniques for the control of noise;
- d) the development of interdisciplinary contacts between noise control engineering and other related fields of work.

The Institute has three classes of membership:

Member Societies (non-profit societies)  
Associate Members (non-profit educational institutions and research organisations)

Sustaining Members (organisations, corporations or persons contributing a fixed annual fee).

The organisation of the Institute comprises a Board of Directors and a General Assembly. The Board of Directors consists of the President, the

Secretary-General of the Institute and seven Directors.

Of the seven Directors, five represent preceding INTER-NOISE conferences, and two are Directors-at-Large. One Director-at-Large is appointed by the Institute of Noise Control Engineering of the United States of America as the founder organisation of the INTER-NOISE series of conferences. The other Director-at-Large, who is responsible for contacts with other organisations concerned with noise control engineering, is appointed by the President.

The General Assembly consists of the President, Secretary-General, Board of Directors and one representative of each member society.

The list of societies who have already been elected members covers:

The Australian Acoustical Society,  
Association Belge des Acousticiens/  
Belgische Akoestische Vereniging (ABAV),  
Verein Deutscher Ingenieure/VDI-Kommissionen Lärminderung,  
The Acoustical Commission of the Hungarian Academy of Sciences,  
The Acoustical Society of Japan,  
The Institute of Noise Control Engineering of Japan,  
Nederlands Akoestisch Genootschap,  
The Acoustical Society of Norway,  
The Committee on Acoustics of the Polish Academy of Sciences,  
La Commission d'Acoustique/  
Academia Republicii Socialiste Romania,  
Schweizerische Gesellschaft für Akustik,  
The South African Acoustics Institute,  
The Swedish Acoustical Society,  
The Canadian Acoustical Society,  
The Danish Acoustical Society,  
The Institute of Acoustics, UK,  
The Acoustical Society of America,  
The Institute of Noise Control Engineering, USA.

Thus the International INCE has eighteen member societies in sixteen countries spread over five continents. Certainly a true international organisation. International INCE anticipates applications for membership from a number of other societies.

### INTER-NOISE Conferences

In fulfilling its aims the Institute sponsors INTER-NOISE conferences in countries of member societies. INTER-NOISE conferences are held in the USA in even-numbered years and outside the USA in odd-numbered



years. The following INTER-NOISE conferences have been held:

- 1972 Washington, USA
- 1973 Copenhagen, Denmark
- 1974 Washington, USA
- 1975 Sendai, Japan
- 1976 Washington, USA
- 1977 Zürich, Switzerland
- 1978 San Francisco, USA
- 1979 Warsaw, Poland

The next INTER-NOISE conference will be held in Miami, USA, 8-10 December, 1980.

INTER-NOISE conferences provide an opportunity for those interested in advancing noise control engineering to gather together for exchange of technical information. Participants in INTER-NOISE conferences may be schematically divided into three categories: acousticians; engineers occupied with noise control in industrial and trade organisations; and administrators occupied in government departments and agencies with noise legislation.

It is important that all three categories be extensively represented at INTER-NOISE conferences. In this way a comprehensive forum is established. Valuable exchange of information on the latest progress in noise control

engineering takes place at the INTER-NOISE conferences, which are the only international forum for such activities.

It is of great importance that progress in research and application of noise control principles should be presented and discussed at international conferences, thus making it possible to pool knowledge and experience from all countries. This is especially important in connection with the establishment of noise control regulations. It is for instance not sufficient that ISO publishes international standards about methods for measuring noise from vehicles. The actual limits, which are outside the province of ISO, should be agreed upon internationally. Discussions at INTER-NOISE conferences may assist in this respect.

#### International/INCE Symposia

The Board of the Institute has decided to extend the activities of the Institute by sponsoring International/INCE Symposia. The topic of a symposium shall be a clearly delimited, fairly narrow topic. A symposium shall have a duration of three to five days, and the number of participants is restricted to a maximum of 75. Participants are invited by the organising committee.

Member societies wishing to organise an International/INCE Symposium shall contact the Institute.

The first International/INCE Symposium is expected to take place during 1981.

#### Newsletter

In fulfilling its aim of exchanging information and news items, I/INCE issues a Newsletter. Fifteen issues have been produced till now.

The Newsletter is intended to provide information on all aspects of noise control engineering. This includes news on INTER-NOISE conferences sponsored by the Institute and on the development of international standards by ISO and IEC. Proceedings of other international and national meetings and other publications and reports submitted to the Institute can also be covered. Developments in the field of national laws and regulations are of particular interest. All subscribers are invited to contribute short notes on current work and future projects, so that they can be contacted by other persons with similar interests at an early stage of their work.

A number of leading institutions and publishers of journals and books in the field of acoustics have agreed to regular publication in the Newsletter of their respective tables of contents. Such information is of considerable value for research workers who do not have regular access to international journals and books.

#### The Future

The International Institute of Noise Control Engineering is a new member of the family of international institutes and societies. It has an important role to play, especially with regard to disseminating knowledge of the principles serving as bases for noise control.

The number of member societies of the Institute is growing continuously. During 1979 three societies applied for membership: the Commission d'Acoustique, Academia Republicii Socialiste Romania, the Swedish Acoustical Society, and the Institute of Acoustics, UK. A number of other societies are considering applying for membership. New activities—such as International/INCE Symposia—are being established.

International/INCE is now a well-established organisation. It may therefore be expected that the Institute will be able to fulfil its aims for the benefit of citizens in all countries. □

## INTER-NOISE 80

INTER-NOISE 80, the International Conference on Noise Control Engineering, sponsored by I/INCE will be held on 8–10 December 1980 at the Hotel Inter-Continental in Miami, Florida, USA. Plans are under way for fourteen special sessions on various aspects of noise control. These are as follows:

- Active Noise Attenuators
- Diagnostic Techniques and Source Localisation
- Industrial and Impact Noise
- Instrument Calibration and Certification
- Land Use Planning Around Airports
- Noise Barriers
- Noise Control Education and Job Opportunities
- Noise in Buildings
- Rapid Transit System Noise
- Shipboard Noise Control
- Structure-Borne Noise in Buildings
- Tyre Noise
- Truck Engine, Cooling Systems and Drive Train Noise
- Valve Noise and Pneumatic/Hydraulic Machinery Noise

Immediately prior to the I/INCE Conference, an intensive short course on Techniques of Noise Control, organised by INCE, will be held at the same venue.

Details of both INTER-NOISE 80 and the INTER-NOISE Seminar are available from PO Box 3469, Arlington Branch, Poughkeepsie, NY 12603, USA. □

# BRANCH AND GROUP NEWS

## North Eastern Branch

The first meeting of the 80s saw a group of our members visiting the works of Burgess Industrial Silencing Limited in South Shields. John Brant, Ron Moore and Jimmy Wong showed their fellow members around the works; they supplemented this with short talks on their Company and its products. An excellent tea rounded off an excellent visit.

The Annual General Meeting as always was held in February (this is to meet the requirements of the Constitution). Traditionally the AGM is accompanied by a Snooker Evening and usually a heavy fall of snow; this year, fortunately, the snow was absent for the first time since the formation of the Branch in 1967.

The joint one-day meeting with the British Society for Strain Measurement on *Recent Developments in Vibration* filled the March spot. About 50 delegates attended this meeting and we were able to chalk up another success to the credit of the Branch.

As in the last session, we arranged meetings at Carlisle in April and Darlington in May; Mike Ankers (Principal EHO, Greater Manchester) repeated his successful presentation *Noise Nuisance North of Watford* at the April meeting; in May John Bickerdike (Leeds Polytechnic) presented his paper on *Discotheque Noise*. Both meetings attracted good audiences and stimulated long and involved discussions. The response to these meetings indicates the great interest in noise matters in these areas; we hope to include meetings at these venues again next session.

The session finished in May on a high note with the Social Evening. This took the form of a talk/demonstration on *Electronic Music* and was held in the Music Department, Newcastle University. Nigel Harrison from the Department presented a musician's approach to the subject; the many varied and different demonstrations which accompanied his talk certainly gave his audience a lot to discuss during the wine and cheese evening which followed.

A keen committee was elected at the February AGM; plans are well in hand for the meetings next session. These include the big one in April 1981 when we host the Institute Spring Meeting.

T Smith

## Building Acoustics Group

Our thanks and best wishes to Chris Gilford who has retired as founder chairman. Geoff Jackson now takes over as chairman and Peter Allaway has joined the committee in place of Hugh Creighton.

An open meeting of the group was held during the Spring Conference in Bedford College on 9 April 1980; action arising from this is now being taken on the following topics.

Chris Walker is planning a very relevant meeting on sound insulation and the Building Regulations Part G; tentative date 26 November 1980, at East Leake. A session on impulse techniques in building acoustics is planned as part of the Autumn Conference 1980 (see IOA Main Meetings). This will not be a haphazard collection of papers but is to be structured to provide an educational and theoretical section, information on instrumentation and current applications and structured discussion of problems and experience in detail, possibly borrowing from other engineering disciplines. As part of the Spring Conference 1981, a session is planned in collaboration with the Musical Acoustics

Group — my preference would be for contributions and discussion on the subject of the instrument — room — listener chain.

Other topics on which we hope to hold meetings are: the Acoustics of Special (non-acoustic) Rooms, eg libraries, court rooms, council chambers, hospital rooms (Geoff Jackson); the vexed question of the commercial and practical difficulties surrounding the Acoustic Specification of Partitions (Peter Mapp); the use of Modelling Techniques in sound insulation, room acoustics and noise propagation (Robin Mackenzie) and, for the more distant future, Room Simulation and Electroacoustics (Paul Newman and Howard Latham).

Interest was shown in the problems of formulating, interpreting and applying community noise regulations. No doubt Mike Ankers would welcome ideas and contributions on this for inclusion in his session on Environmental Noise as part of the Autumn Conference 1980.

I have received some comment on the January 1980 BAG Newsletter and will prepare another as and when appropriate. □

D B Fleming

## Diploma in Acoustics and Noise Control

The increasing numbers of students taking the Diploma course are an additional indication of the rapid acceptance of its academic standard and usefulness. The number of entrants for the June 1980 examinations at 178 is more than double those for 1979. These are from eight approved centres in Britain.

|                                            |    |
|--------------------------------------------|----|
| North East Surrey College of Technology    | 62 |
| Liverpool Polytechnic                      | 25 |
| Newcastle Polytechnic                      | 23 |
| Leeds Polytechnic                          | 18 |
| Tottenham College of Technology            | 18 |
| Bristol Polytechnic                        | 14 |
| Derby Lonsdale College of Higher Education | 10 |
| Cornwall Technical College                 | 8  |

The continuing success of the course is undoubtedly partly a result of the Institute's policy of only approving relatively few Colleges of the highest standard in any area. Each possesses

an appropriately high level of expertise for the number of students admitted. The amount of apparatus devoted to the Diploma in all cases exceeds the £40 000 mark and in some cases is over £150 000.

One of the most encouraging aspects of the Diploma course has been the very high standard of the projects. Several of these have been accepted for publication in journals or as conference papers. In at least one case a student has been accepted for a higher degree as a result of his Diploma project. It is hoped that much wider publicity can be given to the projects in future years and the Diploma Advisory Board are exploring ways in which this may be done. That such first-class work is being produced by students is clearly a result of the ability, enthusiasm and hard work put in by the Course Tutors and Lecturers concerned. □

B J Smith



# London Evening Meetings

On 20 March Mike Ankers treated about 30 of us southerners to a generous helping of fascinating anecdotes based on his experience in dealing with *Noise Nuisance North of Watford*. He did not claim that noise is any different in those more northern parts but there was no doubt that some of the approaches used in dealing with the problems were novel and had a tendency to show the bluntness that those regions are supposed to be noted for.

As an Environmental Health Officer Mike spends a lot of his time dealing with complaints but he started his talk with a few of his own. He was very concerned about the shortage of reliable statistics on the number and type of noise complaints. The EHA Annual Report does publish some figures but he questioned their reliability and felt that the classification was not as useful as it might be. One thing was certain however: the total number of complaints was rising all the time. His second plea was for better access to measurement data. Plenty of measurements were made but the results were filed away and were seldom available to other people who might have to deal with a similar problem. If a standard report form could be established then it would be easier to set up a databank. The data is there, it just needs to be collected.

A large part of the talk dealt with case histories, almost all of which could bear repeating in these columns if only space permitted — which provoked a good deal of lively discussion. With Mike's suggestion that nuisance cases should be assessed subjectively by standing and listening rather than by relying too heavily on objective measurements this discussion became positively heated.

The next meeting, held on 17 April, also relied very heavily on anecdotes but on this occasion the subject was instrumentation as Alan Gibson treated us to a look behind the scenes at Brüel & Kjaer. The subject of instrumentation is extremely wide and Alan began with the microphones that are used today, explaining the differences between the conventional condenser microphone and the newer electret or prepolarised types that are clearly going to replace them. From microphones he moved logically to calibration and explained why it is necessary to have calibrators serviced

and recalibrated fairly regularly. He also recommended that it is good measurement practice to use both the reference tone on the meter and a calibrator to provide a double check on the system.

Standards and regulations pose special problems for manufacturers. When a draft standard is produced, new instruments have to be designed in the hope that when the standard is confirmed it it not significantly different from the draft. This is the position at the present time with the new IEC standards for sound level meters. The proposals for integrating sound level meters are even less far advanced. While on the subject of time averaged units, Alan suggested that a lot of confusion could be avoided if the term  $L_{ax}$  were reserved for the energy level defined by the points 10 dB down from the maximum level, with a different notation such as 'Sound Exposure Level' for an  $L_{eq}$  for an arbitrary period reduced to one second. He also expressed his personal preference for the more honest term 'maximum RMS' rather than the misleading 'peak pressure level'. There was plenty of discussion but a lot of it centred on the selection of instruments, past and present, that were on display. The star of the show was a 1950 Sound Level Meter (mains powered) with its 'larger than life'  $1\frac{1}{4}$  inch microphone from the B & K museum collection.

The final talk of the 1979/80 session was given by Martin Shipton of the National Physical Laboratory, who kindly agreed to stand in for the advertised speaker at short notice. As he put it he 'volunteered' in the face of extreme pressure from his Head of Department.

The whole area of occupational hearing loss is a very complicated one and Martin started his talk by pointing out that we cannot predict how a particular individual will react to a certain noise exposure. Only by considering a large number of people can we make more general predictions about the numbers of people likely to suffer some sort of damage. Burns and Robinson were asked by the Department of Health and Social Security to establish the relationship between noise exposure, age and deafness. Their results were published in a book entitled *Hearing and Noise in Industry* and the relationships given in that report have stood

the test of time for ten years. Martin then went on to show what these findings mean in practice, how they have been incorporated in Standards and Codes of Practice and the extent to which more recent research has refined the relationships.

Clearly there is no such thing as a truly safe level of noise exposure but the variation in the effect on individuals exposed to the same level of noise can be quite remarkable. This was illustrated by pointing out that one man can work in a drop forge for 40 years and suffer no damage to his hearing at all, while another man could become stone deaf in a fortnight. The speaker then went on to identify some of the differences between the International and British Standards and showed that much of the apparent discrepancy can be explained by differences in the way in which the experimental subjects were selected. To complete his rapid tour of a very large topic, Martin described the various types of hearing protector available. Once again it is difficult to make predictions for the individual and this was demonstrated by citing examples in which some experimental subjects had lowered their hearing threshold by putting in ear plugs! □

R C Hill

## NEXT SESSION

Arrangements have now been finalised for the first three talks in the next series. As in previous years, these will be held in meeting rooms in the County Hall, Waterloo, London SE1 and will start at 6.15 pm. The speakers will be:

25 September 1980: I D Griffiths (University of Surrey)

Noise — How Many Annoyed?

23 October 1980: P Riley (AIRO)

Disco Noise — New Guidelines

27 November 1980: B Hemsworth (British Rail)

Railway Noise

Details of the remaining talks will be given in the next Bulletin and any further information can be obtained from:

Robert Hill

AIRO

26/28 Market Place

St Albans

Herts AL3 5DG

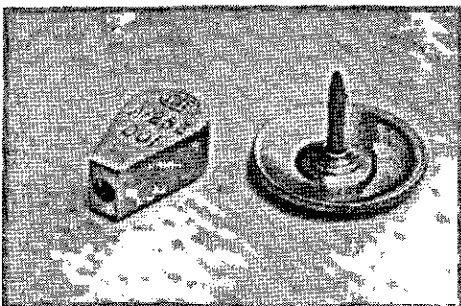
Tel. St Albans (0727) 31176.

# New Products

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

## Sub-miniature Accelerometer A/25/E

D J Birchall Ltd announce the latest addition to their range of high quality piezo-ceramic accelerometers, the A/25/E.



The A/25/E is a sub-miniature accelerometer ( $10.79 \times 6.35 \times 4.70$  mm overall) weighing 1.5 g with a high charge sensitivity of 1.5 pC/g.

The incorporation of D J Birchall Ltd's patented spigot-mounted 'Konic' design, whereby the mass is mounted in annular shear, gives low cross-axial sensitivity and minimises pyro-electric and base strain outputs. Resonant frequency is 80 kHz and maximum continuous acceleration is 5000 g.

The device is of all-welded construction and will operate in temperatures up to 250°C. It is designed for adhesive mounting and connection is via D J Birchall's own sub-miniature micro-dot socket.

Further information from D J Birchall Ltd, Finchley Avenue Industrial Estate, Mildenhall, Suffolk. Telephone: Mildenhall (0638) 712288.

## Innovative Acoustic Enclosure Systems

Developed by the Noise Control Centre of Melton Mowbray, Leicestershire, the unique Telesclosure and Teleslide acoustic enclosure systems are already demonstrating their capabilities in overcoming difficult noise problems in the wire industry.

The Telesclosure allows easy total access to the enclosed equipment. The system incorporates advanced design features which provide increased per-

sonnel safety whilst allowing for installation over any free-standing equipment with the minimum of effort or interference with the enclosed machinery, and yet ensures an overall reduction in noise by some 15 to 20 dB(A).

The telescopic principle developed by the Noise Control Centre enables each noise control section to slide inside or over the next. This concept is eminently suitable for highly automated production lines in factories in which the space between rows of machines is so limited that conventional hinged doors would inhibit access along the gangways.

Requiring minimal maintenance and embodying optional fail-safe interlocks this system offers a practical, economic and flexible alternative solution to factory noise problems, whilst providing ready access to all parts of the contained equipment.

The Teleslide enclosures, again based upon the telescopic principle, are the latest development in a series of innovative acoustic engineered products designed to provide cost efficient solutions to industrial noise control problems.

Available in an extensive range of sizes with design features to suit a wide variety of specialised equipment and

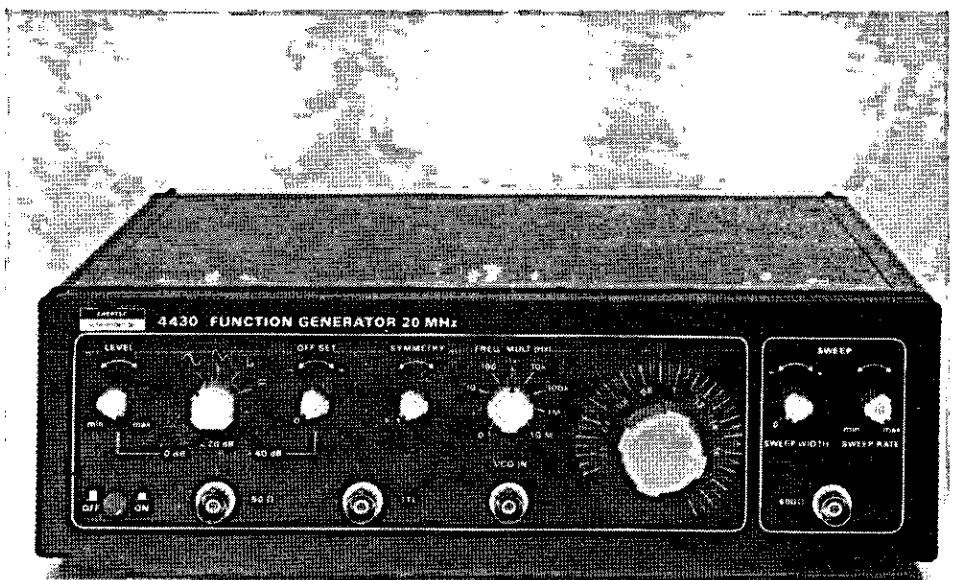
machinery, the Teleslide system incorporates sliding front and rear panels which can be rolled aside with the minimum of effort, without interfering with machine services. Telescopic retraction involves minimum loss of floor space and the system is, say the company, ideal for production lines and equipment not only located in confined areas, but also having extensive machine services provided from above or from one side.

For further information please contact: The Noise Control Centre, Saxby Road, Melton Mowbray, Leicestershire LE13 1BP. Telephone: Melton Mowbray (0664) 67316 or Nottingham (0602) 42444 (24 hours).

## Function Generator 0.01 Hz to 20 MHz

The Enertec-Schlumberger Model 4430 Function Generator combines two generators (F1-F2) in one modular instrument. It features all the usual output waveforms, sine, square and triangular with TTL sync and ramp auxiliary outputs. All main waveforms have adjustable symmetry, from 20% to 80% with a preset position at 50% (the pulse has variable width and the triangle variable slope). The variable offset can be fed to the main output on its own to facilitate setting up and measurement with an analogue or digital voltmeter.

The main generator (F1) can be frequency modulated by an external source or by the internal sweep gener-



Model 4430 Function Generator

ator (F2) and has a frequency-proportional voltage output. A burst input is also provided for on/off modulation.

Specifications are as follows:

Output signals: sine, triangular, square, DC voltage. Variable width and slope from 20% to 80%. Frequency range: 0.01 Hz to 20 MHz in 9 ranges. Frequency accuracy:  $\pm 2.5\%$  of full scale,  $\pm 5\%$  on highest range. Output: 15 V peak to peak into 50 Ohms, 30 V peak to peak open circuit. Offset voltage:  $\pm 7.5$  V into 50 Ohms,  $\pm 15$  V open circuit. Attenuation: 0-20 dB. -40 dB fixed, 0-20 dB variable. Burst input: controlled by positive signal, this input enables the operator to obtain an on/off modulation for F1 signal. Maximum amplitude from 0 to +7 V. Maximum frequency 2 MHz. Frequency modulation: Ramp width adjustable from 30 ms to 30 s, 1000:1 modulation ratio, internal or external.

Fuller details may be obtained from: Wessex Electronics Limited, 114-116 North Street, Downend, Bristol BS16 5SE. Telephone: (0272) 571404.

#### **SOUND RESEARCH LABORATORIES LIMITED**

##### **Senior Acoustic Consultants**

As one of the UK's leading acoustic consultancy firms with involvement in major building and industrial programmes in this country and abroad, we wish to add to our staff of experienced acoustic consultants.

If you have ten years experience of noise and vibration work in any of these areas and wish to further your career development, then please contact us.

There are vacancies at our Head Office in Suffolk, and also in London and Cheshire.

Conditions of employment include salaries, company car, profit share and other benefits.

Telephone or write:—

**N A Grundy  
Sound Research Labora-  
tories Ltd  
Holbrook Hall  
Little Waldingfield  
Sudbury  
Suffolk  
CO10 0TH  
Tel: Lavenham 247595**

## **Book Reviews**

### **Acoustical Design of Concert Halls and Theatres**

V L Jordan

Applied Science Publishers 1980

£18.00

Having already made several unsuccessful attempts to locate this book in the shops before it had reached the shelves, I was delighted to be asked to review it for the Institute of Acoustics; I enjoyed reading it but now comes the moment of settlement.

The book traces Vilhelm Jordan's development from his beginnings as an Acoustician with the Danish Broadcasting Corporation early in the 1940s to his present pre-eminence in the world of Architectural Acoustics. This period covers the years following the war in which many halls were built and corresponds to the inevitable increase in the construction of multi-use spaces for economic reasons.

The paramount importance of the acoustic response of studios (in the absence of visual cues or other aspects of the ambience) coupled with the opportunity to carry out measurements throughout the construction period led Dr Jordan to the formation of certain beliefs regarding the acoustic requirements for reverberation time / frequency characteristics and diffusion which have been important in his subsequent acoustic designs. However, the needs of the musicians and audience were not forgotten and the positioning and shaping of reflecting surfaces were explored both in real spaces and through model experiments. The use of models as a design aid was started by Dr Jordan in the Copenhagen Concert Studio and has

proved a winner ever since — in fact, he obviously still succeeds in convincing his clients of the importance of this aspect.

Perhaps the most persistent image of Dr Jordan over the years has been as the Father of Rise Time, Steepness, and on through Inversion Index etc as criteria for the evaluation of the subjective response of a concert hall or theatre. They are all here, with the progression from one line of thought to the next clearly described together with a limited theoretical justification.

One cannot fail to be impressed by the enormous variety of projects for which he has been responsible throughout Scandinavia, Europe, America and, of course, as far afield as Sydney. In fact this book tends towards being a 'mini-Beranek' with the added interest that all the projects are modern and the work of one consultant. Each chapter lists the principal characteristics of the halls together with a useful indication of the acceptable limits of criterion values.

I know that if I complain about the price each party involved in writing or publishing or selling the book will tell me how little profit they make. I may not know where it all goes, but I do know who foots the bill for those that aren't fortunate enough to have a review copy. Nevertheless I would have bought this book anyway just as I would advise anyone with a professional interest in concert halls, acoustic design and the like to rush and buy it, thus obtaining an insight into the methods used by Dr Jordan whose expertise and skills have resulted in so many successful projects. □

Alex Burd

#### **Errata**

The mistake that is every editor's nightmare occurred in the April issue of Acoustics Bulletin. The last sentence of paragraph 6 of the report on Noise in Cities reads, incorrectly, 'His general conclusion was that we were better off without [the Noise Guidelines].' Far from it! The speaker's general conclusion was, in fact, 'that we were better off with them than without them.'

In the same issue, on p 9, the affiliation of P H Allaway should have been given as Grootenhuis Allaway Associates and Allaway Acoustics Ltd.

We apologise to those concerned for any misunderstanding or inconvenience caused by these errors.





# Institute of Acoustics Meetings

## 1980

|                 |     |                                                                                                                                                                                         |                                             |
|-----------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| 15 July         | M   | Microprocessor Applications in Acoustics                                                                                                                                                | University of Birmingham                    |
| 11 September    | M   | Noise Control in Hospital Buildings<br>(in collaboration with The Institution of<br>Plant Engineers)                                                                                    | New Hackwood Hotel, Bromley                 |
| 22-23 September | M   | Diesel Engine Noise Research                                                                                                                                                            | University of Technology,<br>Loughborough   |
| 24 September    | SG  | Speech Intelligibility                                                                                                                                                                  | University of Aston                         |
| 25 September    | LEM | Who's Annoyed by Noise?                                                                                                                                                                 | County Hall, London                         |
| 8 October       | M   | Acoustical Standards                                                                                                                                                                    | National Physical Laboratory,<br>Teddington |
| 23 October      | LEM | Disco Noise — Can the Problem be Con-<br>tained?                                                                                                                                        | County Hall, London                         |
| 2-4 November    | M   | <b>AUTUMN CONFERENCE</b><br>(Environmental Noise; Aerodynamic Noise;<br>Impulse Methods in Acoustics; Open Ses-<br>sion)                                                                | Hydro Hotel, Windermere                     |
| 27 November     | LEM | Railway Noise                                                                                                                                                                           | County Hall, London                         |
| 15 December     | M   | Acoustic Pattern Recognition<br>(Joint with the British Pattern Recognition<br>Society)                                                                                                 | University of Surrey                        |
| 16-17 December  | UA  | Transducers for Sonar Applications                                                                                                                                                      | University of Birmingham                    |
| 16-17 December  | M   | Elastic Waves and Microstructure<br>(Joint with the Metals Society, Materials<br>and Testing Group of the Institute of<br>Physics and British Institute of Non-<br>Destructive Testing) | Hertford College, Oxford                    |
| 17 December     | SG  | Speech Perception                                                                                                                                                                       | University of York                          |

## 1981

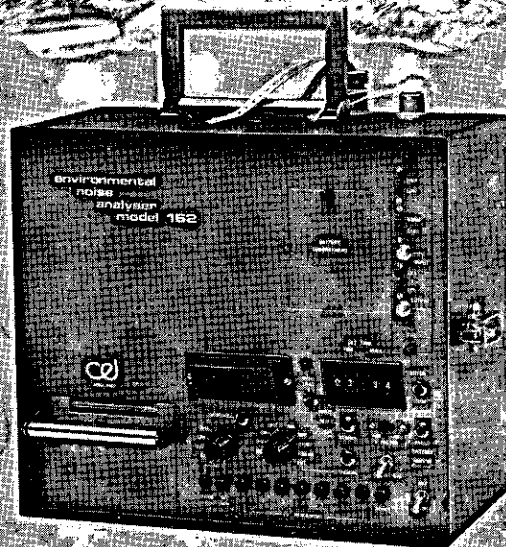
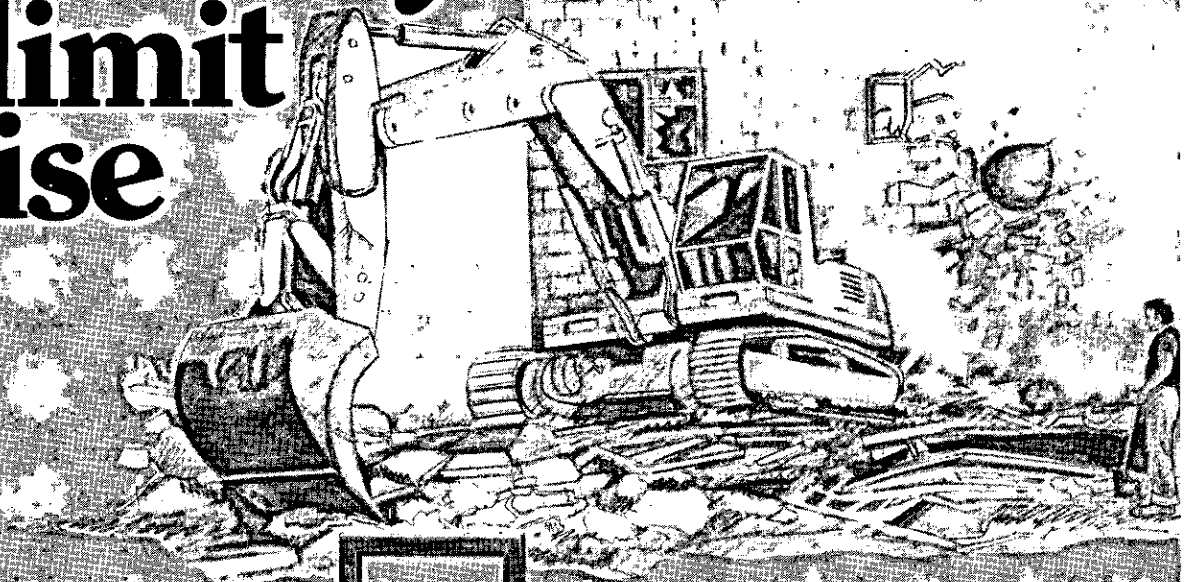
|                |   |                                                                                                                                                            |                         |
|----------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 19-20 February | M | Active Control of Noise and Vibration                                                                                                                      | University of Essex     |
| 22-24 April    | M | <b>SPRING CONFERENCE —<br/>ACOUSTICS 81</b><br>(Including sessions on Speech Research;<br>Musical Acoustics; Structural Vibration and<br>Industrial Noise) | University of Newcastle |

### Key

M=Meetings Committee Programme  
UA=Underwater Acoustics Group  
SG=Speech Group  
LEM=London Evening Meeting

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

# It's so easy to limit noise



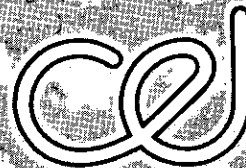
## with the CEL-162



The CEL-162 Environmental Noise Analyser provides, within its fully weatherproof enclosure, a complete precision acoustic measuring, analysing and recording system. Capable of supplying all the information needed for a complete investigation into community noise problems, the CEL-162 can be left unattended for several days.

The instrument incorporates a digital autoranging sound level meter and can provide both period and cumulative  $L_{eq}$  values — by the true energy integration process — and up to seven simultaneous  $L_n$  values. Answers are calculated in real time and are recorded on the self-contained printer. In addition to the functions found in the standard instrument, the CEL-162LAX model includes a threshold detection arrangement that causes the time, duration, maximum and energy level of each event above the threshold to be separately printed.

*For full technical details of the CEL-162 and all its variants contact:*



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