



Acoustics Bulletin

July 1983 Volume 8 Number 3

INSTITUTE OF ACOUSTICS

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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 £4.00

Annual subscription (4 issues) £12.00

ISSN: 0308-437X

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Volume 8

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

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

Membership of the Institute of Acoustics

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

Honorary Fellow (HonFIOA)

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

Fellow (FIOA)

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

Member (MIOA)

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

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

Associate

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

Student

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

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

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Presidents Letter

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Dear Member,

The new Council met for a special session on the proposed Noise Council on 7th April, and had its first normal meeting on 26th May. In my last letter I commented on changes concerning the Officers. Regarding Ordinary Members of Council, we said goodbye with regret to Robin Mackenzie, we were pleased to greet Tony Pretlove and Chris Rice, and to see again Ernie Scholes transformed from a co-opted to an elected Member.

When Council accepted new Members into the Institute it was noticed what a high proportion were Environmental Health Officers, being a reflection of the fairly high numbers already in the Institute, and I record this as a matter of passing interest. I believe it is a strength of our Institute and of Acoustics itself that it draws workers from many fields, and certainly noise in the community is one important field. (Adjectives like interdisciplinary and international are a little fancy but I admit to liking them.) It is a pleasure to welcome these workers in noise and those in the other acoustic subjects.

During the summer Council has a relatively long break from formal meetings. But this does not mean idleness, and activities range from running of Inter-Noise to deliberations on the Noise Council. Meanwhile I wish everyone a warm and certainly a harmonious summer season.

Yours sincerely,

David Weston

Letters to the Editor

Dear Madam,

BS 4142

The objective ranking of the degree of annoyance due to any intruding stimulation is likely to be troublesome, for the human brain employs an incredibly complex procedure for making its assessment.

However the advantages of objectively ranking the degree of annoyance are so great that it is clearly worth while, for experience shows that any subjective ranking can be heavily biased by emotion, prejudice, private interest, undue sensitivity or insensitivity or by environmental extremism.

BS 4142 attempts to provide an objective technique for predicting the degree of annoyance and experience shows that it is a good, but not perfect, Standard. The failings are largely in the editing, for the phrasing provides adequate support for any pseudo-lawyer anxious to demonstrate that the Standard cannot be applied to his particular problem. Criticism of the technical content of the Standard is rare. It is the purpose of the note to list the technical areas in which our experience suggests that the Standard falls short of its target.

Intermittent noises are ranked on the basis of the Time on/Time off ratio, by both BS 4142 and R 1996. This does not accord with experience. The immediate effect of 'intermitting' a noise is to make the noise more annoying and not less annoying, for the same received noise power. For large Time on/Time off ratios a ranking on a received power basis seems more reasonable and in accord with experience when the 'step' is less than about 10 dBA.

The inclusion of a pure tone component in a wide band noise does not appear to be adequately penalised by the addition of 5 dBA. I think that sufficient research data on this problem is available in the literature but it may well be that its inclusion in the Standard would unduly complicate the assessment.

The Standard places no limit on the lowest level to which the 5 dB excess rule can be applied. It appears utterly unreal to assume that noise levels below about 25 dBA should be so protected, particularly in a city centre.

The technique described for predicting a reasonable ambient level is excessively generous and is unnecessary. In more than twenty years practice we have

never found a situation where the ambient noise level could not be measured, even in the presence of the intruding noise. Green field situations could be adequately protected by accepting the 35 dBA value suggested by the Wilson Report as a reasonable external ambient level in new locations.

In view of the immense advantages of using an objective technique, I regret that the minor weaknesses of the Standard are so frequently used to reject its use. Dealing with an excessive noise situation through the legal processes is such an expensive experience that it is quite impossible in the majority of situations.

Yours sincerely,
James Moir

Dear Madam

Hearing Damage Legislation, a Case for Arbitration

The article by A J Jones (April) is of interest in showing side by side the conflicting estimates of hearing handicap risk published by the EEC and the HSC. Each seeks to justify its legislative proposals by reference to handicap risk data, so it is not surprising that the proposals differ.

Calculated hearing handicap risk depends on two factors, the numerical criterion of handicap chosen and the hearing threshold data base used. The HSC document specifies both its criteria and its data base, the EEC document

specifies neither — which is an indication of the technical quality of the EEC document.

Working with Acoustic Technology Ltd, I have made a study of the technical validity of the EEC proposals with regard to the thresholds for hearing protection and for routine audiometry. We took ISO/DIS 1999 (1982) as representing the most recent, authoritative, international data base, and put its equations into a computer program (this was made more difficult than it should have been because there are several misprints in ISO/DIS 1999). We then re-calculated the risk percentages and the relative importance of noise and age effects for each handicap criterion. We reviewed also the validity of the EEC, ISO and BS criteria of handicap.

The EEC in fact uses ISO/DIS 1999 as a data base (1) whereas the HSC uses British data bases including BS 5330, which do not take account of some more recent data. The EEC handicap criteria are 15 dB ('perceptible') and 30 dB ('definite') average hearing threshold level at 1, 2 & 3 kHz (1). This latter is, arguably, the true threshold of handicap and is taken as such by BS 5330. Incidentally, the term handicap itself requires definition; we have used the WHO definition (2).

We considered also the rate of acquisition of noise induced permanent threshold shift and the repeatability of routine audiometric measurement. From this it was clear that routine audiometry is of no value for detection of NIPTS at continued exposure levels below 90 dB(A) L_{eq} 8h. There will be

EEC Directive on Noise: Short Courses at Loughborough

A one-day seminar and a short course to be held in November 1983 by the Centre for Extension Studies of the University of Technology, Loughborough, centre on the EEC Directive on Noise to come into force by the end of 1984.

The seminar, on 7 November, will discuss the provisions of the Directive indicating what type of measurements or preventive action will need to be taken. (Non-residential: £65.)

The course, Noise Control and the Protection of Hearing at Work, from 8 to 11 November, is designed for personnel from any type of organisation where noise is, or could be, a problem; it is a practical problem-based course designed expressly to deal with the requirements of the EEC Directive. (Residential: £280.)

The residential fee for those attending both the seminar and the course is £340. Further details are available from:

Mrs S M Withers
Centre for Extension Studies
University of Technology
Loughborough
Leics LE11 3TU.

no appreciable risk of this if properly selected hearing protectors are worn to reduce actual exposure to 90 dB(A) unless the unprotected exposure level is at least 95 dB(A).

This work was written as a Critique of the EEC proposals commissioned by the CBI and EEF, and recently published (3). I agree with Dr Jones that there is an important value judgement to be made and hope that this Critique will be a useful contribution to the whole body of information required for this judgement to be made.

Yours faithfully,
Peter Sutton

References

1. Verbal communication by Dr van der Venne, EEC.
2. *International Classification of Impairments, Disabilities and Handicaps*. WHO, 1980.
3. *Noise Exposure Limit Values and Audiometry: a Technical Critique*. P Sutton, Acoustic Technology Ltd. Engineering Employers Federation, Broadway House, Tothill St, London SW1H 9NQ. April 1983. Price £10 to members, £20 to non-members.

BSI at Milton Keynes

Since 1 June 1983 several important departments of the British Standards Institution have been established in the new regional centre at Milton Keynes, which is designed to accommodate BSI expansion over the next 20 years. They include **Sales, Technical Help to Exporters, Information** including the **BSI Library, Marketing and Accounts**. All correspondence and enquiries to those departments should be addressed to:

BSI

Linford Wood

Milton Keynes

MK14 6LE

Tel: Milton Keynes (0908) 320033. Telex: 825777.

The new library, combining the separate facilities formerly provided in London and Hemel Hempstead, will contain the largest collection of standards, regulations and technical requirements in the world. Publications for purchase — British Standards, foreign national standards, ISO and IEC publications, CEN and CENELEC standards, and other foreign specifications and regulations — will all be available from one source, the Sales Department at Milton Keynes.

A new enquiry service has been set up to advise customers on any aspect of BSI's functions or publications and also deal with their orders. It has its own telephone number: 0908 320066. □

IOA Education Committee

It is now five years since the first IOA Diploma Examinations were held. The first four Colleges, Cornwall Technical College, Liverpool Polytechnic, North East Surrey College of Technology and Newcastle Polytechnic were asked to present a review of their course and an update of their resources. It was pleasing for the Education Committee to note the developments which each College has made and the continued improvement in equipment resources. There was no doubt that these Colleges continue to be centres of excellence.

The modular approach to the Diploma has undoubtedly been a contributing factor to its success. This year over 200 candidates entered the examinations. A significant number were taking additional specialist modules, having already obtained the Diploma. This must surely be a tribute to the standard of teaching as well as to the relevance of the units. As part of the continued development an additional specialist module in Instrumentation is to be added for the 1984 examinations.

As well as taking some easy decisions the Education Committee has had to make some less pleasant but necessary recommendations. One of these has been with regard to examination entry fees. For the 1984 examinations these will be:

Registration	£15
General Module	£15
Specialist Module	£10
Project	£10

The change has been limited to a modest £2.50 increase for the specialist modules and the introduction of a charge for the project. Whilst any increase is undesirable it is hoped that these changes will be seen as reasonable ones. Another difficult decision has been to fix a firm latest date for submission of projects. The Committee, whilst in full sympathy with the difficulties part-time students may have in completing projects to time, have decided that the end of June is the latest time for submission of a project if an award is to be made in that year. The exceptional special case may be considered for a small extension.

Just before Christmas of 1982 some very successful Sixth Form Lectures by Professor Peter Lord and Dr Peter Wells were held at Portsmouth Polytechnic, Leeds Polytechnic and Ulster Polytechnic. It is hoped to organise some similar events in Cardiff, Surrey and Edinburgh just before Christmas 1983. □

B. J. Smith

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ISVR— The First Twenty Years

This year marks the twentieth anniversary of the founding of the Institute of Sound and Vibration Research, at the University of Southampton. Its three Directors during these twenty years have had a profound influence on the success of this unique institution. The following brief articles record their experiences during their term as Director.

Professor E J Richards

In 1950, the consuming topic of research in aviation was the excessive noise from aeroplanes and how to reduce it. At Southampton the consuming topic was the coming of age of its University College to be a fully fledged University (1952) and the need to establish itself as a centre of research. In aeronautics, its conventional research equipment was primitive indeed, and the whole School of Engineering had only one research student (and he failed).

I had been an aeroplane designer with Vickers, where I had seen the new turbo-propellers and jet engines introduced, and recognised the possibility of jet and propeller noise and its effect on structural fatigue as a forward looking and relatively inexpensive area of future study, and that is how it turned out. Acoustics was a highly unfashionable subject in general, and over the decade to 1960, the aeronautics department attracted an ever widening range of lecturers and subjects in the topic, some of them bringing their own funds with them from the automotive industry, the Navy, the world of hearing conservation, and in stochastic processes. Novel equipment was built (for example, the first space-time correlator) and new techniques grew from this. As a result, by 1961 the research tail was furiously wagging the aeronautical dog, and I decided that if aeronautics was to grow, acoustics should separate out into a clearly defined Institute of Noise and Vibration Research.

With this University finding its feet, and with many Arts lecturers feeling that 'noise' was some unworthy kind of emotive word like 'bother' or 'petty nuisance', which would soon go away, it took three years of hard pleading before eventually an Institute of Sound and Vibration Research emerged, with considerable backing by the then Science Research Council, and with an enthusiastic and highly competent staff, many of whom have since then established well-deserved international reputations either at Southampton or elsewhere. A Journal of Sound and

Vibration was established which, under the editorship of Professor Doak, has become a premier English language journal, giving an outlet to the publication of a wide programme of research. The ISVR has not forgotten, either, that communication via short and long courses and consultancy is just as important as research itself; in other words, that the art of using knowledge is itself the best form of knowledge.

It is not surprising, therefore, that the University world has now recognised the value of ISVR and its methods, and that both the first two Directors have gone on to the greater responsibilities of leading whole Universities, myself becoming the Vice-Chancellor of Loughborough University, Professor Clarkson the Principal of Swansea University College.

Professor B L Clarkson

I took over as Director in 1967 and the next decade saw a period of rapid growth from the solid foundations laid by Professor Richards. The early part of this period coincided with a period of great expansion in the University system as a whole and towards the end severe economic pressures were beginning to be felt.

The special purpose acoustic test facilities were completed and opened as the Rayleigh Building by Sir Donald Stokes in 1969. Shortly after this the Tizzard building extension provided additional office, teaching and general purpose research space for the growing academic and research staff. The major central research facilities were complemented with the high speed on-line data analysis centre based first on the Myriad Computer and then updated to the present PDP 1145 system. These unique test and data analysis facilities enabled a strong experimentally based research programme to develop.

The formal teaching continued to be centred on the postgraduate Masters Course on Noise and Vibration Studies. Additional course units were gradually introduced to allow some specialisation and then later two further major group-

ings were marketed as separate courses. These were an M Sc in Audiology and an M Sc in Environmental Aspects of Diesel Engine Design. These courses provided a good basic formal training for our Ph D research students in addition to the provision for about 30 M Sc students per year.

A major feature of the research programme was the development of strong links with Industry and Government Research Establishments. Joint research programmes were initiated and strengthened by the appointment of industrially sponsored staff. These staff had a specific responsibility for liaison with the sponsoring company, spending the equivalent of one day per week on work of direct interest to the company and developing research programmes in collaboration with the company's own staff. Under this general scheme Hawker Siddeley Aviation established a Chair, Rolls-Royce a Readership, and Lectureships were provided by British Leyland, Perkins, and Cummins. A Research Fellowship sponsored by the CEEB was also converted into a Lectureship. On the medical side the Wessex Regional Health Authority supported the development of the audiological work. Professor Coles, initially seconded by the Navy was 'taken over' by the Health Authority. The Clinical Audiology Unit, formed by Professor Coles, provided a specialised diagnostic service to consultants in the region. This breadth of support enabled the research work originally based in the Aeronautics Department to grow into the major industrial areas of diesel engine noise and into the health and community areas of the effect of noise on people. The strong support for applied work was underpinned by continuous support for more fundamental work from the Research Councils.

The demand for help with routine surveys and noise measurement and assessment soon became too much for the existing staff to handle in their 'spare' time. With the help of a pump priming grant from the Wolfson Foundation the Wolfson Unit for Vibration Control was set up. This proved to be a very successful group of professional consultants and provided the academic area of the Institute with many valuable industrial and establishment contacts. Later an Automotive Design Advisory Group was established on similar lines. This enabled the suites of acoustic test chambers for running large Automotive Diesel engines under load to be developed. It was more difficult to maintain the financial stability of this group because by the very nature of its work it depended on large con-

tracts. A delay of a few months in negotiating a contract or last minute changes in company policy could cause severe strains.

International contacts were developed by staff exchanges and visiting Professorships. Close working links were established with the new University of Technology at Campiègne by Professor Doak and Professor Perulli. Our M Sc year was offered as an integral feature of the French degree scheme and we have benefited from a regular group of French students on our course each year. A different arrangement was made with the George Washington University to provide a joint MS degree scheme on site at the Langley Research Centre of NASA in Virginia. Our staff went over on secondment for several years to help to get the course going.

Staff of the Institute have taken a leading part in the development of acoustics at national and international level. The Eighth International Congress on Acoustics was held in London in 1974. Professor Richards was President of the Congress and I was Chairman of the Organising Committee. Following this I was Secretary of the International Commission on Acoustics for two three-year periods.

Towards the end of this decade the wheel turned full circle and Professor Richards returned to become Research Professor with the responsibility of building up a research activity in industrial noise.

Professor John B Large

Under the directorship of my two predecessors, the Institute was spectacularly successful. The momentum generated by the original concept and by the enthusiasm of the staff ensured growth and research ingenuity. But, as with all mature organisations, there comes a time when a re-evaluation of purpose is necessary. The beginning of my directorship was such a time. Total income from the UGC and the research agencies was beginning to decline, and the needs of society were also changing. For example, environmental noise was no longer a prominent national issue. Although the latter was not a particularly important income generator, the issues were of general interest and provided a platform which enabled ISVR to be frequently heard by government and the general public.

Just before my term of office, the Institute had abandoned an undergraduate course in engineering science and had commenced another in

acoustical engineering. Great effort was required to organise this course to make it academically viable and attractive to students, a process which must still continue. Our three M Sc courses had to be reviewed for they had evolved over many years and had reached a stage which required the department to decide whether to continue these courses or to consolidate.

The research activities were stimulated by giving each research group a greater degree of autonomy. Each group had an annual income in excess of £200,000, larger than many single departments, and therefore it seemed sensible to allow them a greater sense of financial control. This was also accompanied by an amalgamation of some of the older groups and the creation of others to match the changing research interests within the department. This reorganisation appeared to have the desired effect as income, both academic and research, began to climb again; a notable achievement by the Institute, when coupled with the general economic climate, particularly in the automotive and mechanical engineering industries.

I regard the period of my directorship as one of consolidation and re-evaluation. I believe this has strengthened the organisational structure of a department too large and too diverse in its range of interests for the usual loosely knit administration of a traditional University department. New and younger staff have been recruited, a variety of new research topics have been initiated, and our teaching courses under the traditional framework and those of continuing education, are well supported. The next twenty years are assured.

TWENTIETH BIRTHDAY CELEBRATIONS

ISVR's Twentieth Birthday was celebrated in style at Glen Eyre Hall on Saturday 9 July. The event was a formal affair, to which all ex-staff and alumni, former students, technical staff and the entire present department were invited. Those who missed the celebrations will be able to read about them in the October Acoustics Bulletin. □

Short Courses in Noise and Vibration at ISVR

Industrial Audiology and Hearing Conservation — 12-16 September 1983

This course is intended for industrial medical officers, occupational hygienists, safety officers, senior occupational health nurses and others involved in audiology and hearing conservation programmes in the industrial environment.

The outline syllabus is as follows: Basics of Hearing and Noise; Hearing Conservation Programmes; Audiometry; Audiometric Programmes; Audiometry Practicals; Regulations and Legislation; Tutorials and Demonstrations; Assessments.

12th Advanced Noise and Vibration Course — 19-23 September 1983

This is the twelfth time this famous advanced-level course has been presented. It has broadened and strengthened very considerably over its 25-years lifespan. It is aimed at researchers and development engineers in industry and research establishments, and people in other spheres who are associated with noise and vibration problems. There are over thirty lectures, including the basic subjects of acoustics, random processes, vibration theory, subjective response and aerodynamic noise, which form the central core of the course. Several specialist applied topics are offered, including aircraft noise, road traffic noise, industrial machinery noise, diesel engine noise, process plant noise, environmental noise and planning and laser techniques for non-contact measurements. Course material includes *Noise and Vibration* (edited by R G White and J G Walker) which owes its origin to this course.

Applied Digital Signal Processing — 26-29 September 1983

Intended for engineers and scientists who wish to keep abreast of modern methods of signal processing with particular reference to dynamic testing. The material will be of particular benefit to engineers in industry and from research and teaching establishments and is also suitable for technical managers who need to evaluate the application of digital computer technology and digital data analysis to realistic problems.

Understanding Noise — A one-day basic appreciation course — 5 October — ISVR; 10 November — Midlands

The course will deal with the fundamental concepts of acoustics. These will be explained in a way that can be understood by those who have not had any formal acoustical training, but who are, however, concerned with acoustics and noise in their work. It is aimed at providing the base upon which they can develop their skill, so that simple terminology and problems can be understood and solved. □

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THE INSTITUTE OF ACOUSTICS

NINTH ANNUAL REPORT

OF THE COUNCIL 1982

In 1982 the organisational structure of the Institute of Acoustics extended, for the first time, beyond the shores of the British Isles. The Hong Kong Branch of the Institute of Acoustics was inaugurated in July, and, in a parallel development, the Hong Kong Polytechnic Associateship Course in Noise and Vibration Control was instituted and accepted as meeting the academic standard for corporate membership of the Institute: subject to satisfactory external examiner's reports, approval has been given for an initial period of five years, after which it will be reviewed.

As part of the process of improving the co-ordination of Branch and Group activities, and the strengthening of local membership structure, a meeting of representatives was held towards the end of the year at which it was decided to introduce a number of measures for improving communication between the various bodies, in order to avoid meetings clashes and generally to aid co-operation. The meetings nominated Mr Trevor Smith to continue as Vice-President with Special Responsibility for Groups and Branches, thereby expressing their confidence and satisfaction in his efforts on their behalf since assuming this office, a contribution which Council wishes gratefully to acknowledge. The Yorkshire and Humberside Branch held its official inaugural meeting in December, and it is expected that an East Midlands Branch will seek Council's approval in 1983.

In anticipation of future developments in the area of professional status and qualification, Council has requested the Membership Committee under its new Vice-President, Mr John Bickerdike, to initiate an enquiry into the mechanisms and possibilities for ultimate qualifications of the Institute of Acoustics for 'Chartered' status: because of the nature of the procedures involved this question will inevitably take a long time to be resolved. On the education front, the Diploma continues to attract a satisfactory number of candidates and standards remain high. In response to an initiative of the Association of Noise Consultants, Council has set up a joint working party with ANC to look into the possibility of the introduction of a post-diploma qualification.

In April, the President Elect, Prof David Johns relinquished his two-year long role as Chairman of the Membership Committee, and took on the responsibility for the Publications Committee from the new President, Dr David Weston. Council wishes to acknowledge the contributions of both Vice-Presidents to these two vital functions of the Institute.

Under Professor Johns' guidance, the Publications Committee has recommended that, from January 1983, publication of somewhat enlarged papers as proceedings of meetings should be rationalised in the form of parts of annual volumes, to which Council has readily agreed, noting the advantage of increased archival convenience and commercial viability.

During the year the Institute of Acoustics was accepted for Associate Membership of the Council for Science and Technology Institutes, a body of eminent representatives of smaller, specialised learned societies and institutes, which aims to make known as widely as possible the part that science and technology play in modern society and to form a channel of communication of the common views of its member bodies to government, industry and other important bodies, such as the Engineering Council and the Royal Society: the CSTI has an important role in relation to matters of professional education and codes of conduct. Membership of the CSTI will in no way constrain the Institute in its freedom to act or speak independently.

Of the many matters to receive the attention of Council during the past year, that which promises to have the most important and far-reaching effects is the promotion of the establishment of a independent body to resume, and to extend, the function of the disbanded Noise Advisory Council. The Council of the Institute of Acoustics' decision early in 1981 to form an advisory group with the brief of seeking advice and support for the initiative from former members of the NAC and from other interested organisations, was proved timely by the request in December 1981 from the Royal Commission on Environmental Pollution for evidence for a new report on all aspects of environment pollution. Meetings of the group with ex-NAC members, and with an ex-chairman, the Rt Hon Eldon Griffiths, MP, led to a proposal to Council for the establishment of a steering group to prepare draft terms of reference for, and to advise upon membership and finance of, a proposed independent body which would study noise problems, including those of industry, and produce recommendations and comments upon proposed legislation and standards. The intention is not to produce a political lobby but to gather a well respected and authoritative membership, from a broad range of society, who will speak as individuals and not as representatives; the proposed name is the 'Noise Council'. Council accepted the proposal, and has invited Professor G M Lilley to chair

the steering group, which office he kindly agreed to perform.

Since the inception, in 1977, of the Diploma in Acoustics and Noise Control, Dr R W B Stephens has performed the onerous duty of Chief Examiner, a task made much more difficult in the case of an entirely new qualification by the complete lack of reference points or yardsticks. In the year of his 80th birthday, Dr Stephens passed on the mantle to Dr H G Leventhall, although not escaping completely in his role as deputy. Although the most obvious sign of the success of the course is the numbers of colleges and qualifiers involved, the real success lies in the degree to which the academic and professional aims of the course have been met, and in his generous guidance on quality and uniformity of standards, Dr Stephens has played a major part in that success. Council wishes to acknowledge an enormous debt of gratitude to Dr Stephens for his work as Chief Examiner, coupled with a fond wish for many happy returns. Council is also delighted to announce that Dr Stephens has given permission for an annual lecture to be named after him.

A most welcome development on the educational front was the reintroduction of the sixth-form lectures, the first two of which were most successfully presented in Leeds, Portsmouth and Ulster.

Every two years, the passing over of the Presidential chain of office signals metamorphoses from President to Immediate Past President, and from President-Elect to President: in April 1982 the protagonists in this drama were Professor Brian Clarkson and Dr David Weston. Professor Clarkson had presided over the introduction of a co-ordinated policy towards the development of Groups and Branches, which was implemented by the establishment of the office of a Vice-President with special responsibility for this fundamental aspect of the life of the Institute. He was to play an important role, later in the year, in the initial steps towards the establishment of a Noise Council, a development which is proceeding under the Presidency of his successor on that occasion: in addition he became President of FASE. Council wishes to place on record an appreciation of the enthusiasm and skill with which Professor Clarkson guided and motivated the Institute during his term of office.

Also retiring from office in April 1982 was the Immediate Past President, Professor Peter Lord. In acknowledging the very considerable contribution made by Professor Lord to the development of the Institute, Council wishes in particular to record that Professor Lord presided over the vitally necessary, but often very difficult, process of transferring the headquarters office to Edinburgh, which ultimately brought the Institute financial and organisational stability.

At the close of the year the total number of corporate and non-corporate members stood at 835 and 316 respectively. The number of sponsor members is 13.

STANDING COMMITTEES

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

Meetings Committee

The work of the Committee has been strongly influenced by long term planning for Inter-Noise in 1983. A decision was made to reduce the number of noise-related meetings in the latter part of 1982 and this proved to have been well advised.

The year opened with a re-run of the meeting on Sound Propagation Outdoors which had been badly affected by travel difficulties due to snow in December 1981. There was a total of 33 registered participants. In February the meeting on BS 4142: Reviewed and Criticised attracted 68 participants and was notable for its active discussions. The Spring Meeting at Guildford in March had 130 participants who enjoyed the excellent setting and appreciated the efforts of the Organising Committee on their behalf. Noise Control in Factory Buildings drew 65 participants to Cambridge in May to listen to a full and varied programme of papers, followed by energetic discussions.

There were two meetings in September: a one-day meeting on Design and Use of Acoustic Test Rooms had 44 participants, whilst a major meeting at Edinburgh on Auditorium Acoustics attracted 83 delegates, many of them from abroad. Council are indebted to the Building Acoustics Group committee for the organisation of these two latter meetings. The year concluded with the Autumn Meeting at Bournemouth to which 92 participants came. A highlight of this meeting was a presentation to Ray and Ellie Stephens to mark Ray's 80th birthday. In addition to the Meetings Committee programme, there have been joint meetings with the Hospital Physicists' Association and the Institute of Physics.

Meetings are dependent upon the skill and enthusiasm of the organisers. The Committee wishes to record its thanks to those who have worked so hard for the Institute, in addition to pursuing their own busy professional lives.

Membership Committee

The Membership Committee met 5 times during 1982 and considered 164 applications from individuals, of which 147 (90%) were successful, and 1 for sponsor membership. Details of the distribution of members in the various grades are given in Table 1. The trend in membership of the Institute is still upwards although the rate of increase is now slowing down. A disturbing feature of the membership issue is the number of members who resign or are removed from the list for non payment of fees. This year 2 Fellows, 27 Members, 56 Associates and 15 Students were so lost (a total of 100 individuals) together with 3 sponsor

members representing a loss of some £2500 in revenue to the Institute. The high loss of Associate members can be explained by the failure of Diploma candidates (either successful or unsuccessful) to continue their membership following their free membership year during the Diploma course. More serious concern must be expressed at the loss of Corporate Members and Fellows and the committee intends to investigate the problem in 1983. Efforts are continuing to widen the appeal of sponsor membership and the committee have asked all members to publicise the benefits of sponsor membership to their commercial contacts. The committee are also currently re-examining the range of qualifications acceptable under the membership bylaws with a view to recommending changes to Council on a broader range of subjects.

Grades of Membership	1981	1982	Applications in 1982	Successful Applications in 1982
Fellow	194	201	12	9
Member	590	634	85	71
Associate	294	301	63	63
Student	26	15	4	4
Total	1104	1151	164	147
Sponsor	16	13	1	1

Table 1 Details of membership

Publications Committee

The Acoustics Bulletin remains the principal means of communication between the Institute and its members. The Editor, Mrs Alison Hill, has continued the high standard of previous years with four quality issues covering news of meetings, Groups and Branches, articles of general interest, book reviews and special features, etc. As far as possible abstracts of, or reports on, all major main meetings and group meetings are presented.

Following discussion by the Committee, the Meetings Committee and Council, it has been decided that the Institute will, beginning in 1983, offer the Proceedings of IOA Conferences and Meetings each year as a complete annual publication. Authors will be encouraged to prepare longer papers (up to 8 pages) and with the prospect of a permanent record being produced, we hope for an even higher standard of papers offered. Libraries and individual members will be able to subscribe for each Annual Volume, or, as now, for single parts which will comprise the papers presented at each individual meeting.

Education Committee

Council reports another successful year, with 157 students taking the Diploma examination in 1982 and 69 qualifying for the award of the Diploma; others were taking extra module courses. The Institute of Acoustics prize was awarded jointly to Mr A R Caruthers, who studied at Colchester Institute of Higher Education, and Mr R K McLaughlin from Heriot-Watt University. Projects were again of an exceptionally high standard and the ANC project prize was awarded to Mr R G Whitehead from Colchester Institute of Higher Education.

The Education Committee wishes to reinforce the sentiments expressed earlier in the report by Council upon the retirement of Dr R W B Stephens. We are fortunate in that Dr H G Leventhall has agreed to become Chief Examiner.

As reported in last year's Annual Report, Council decided that the Diploma Advisory Board should take on a wider role and be renamed the Education Committee. One of the notable events has been the Institute's Christmas Lectures for Sixth Form students at Portsmouth, Leeds and Ulster Polytechnics. Professor Peter Lord and Dr Peter Wells spoke on *Digits to Music* and *Medical Ultrasonics* respectively. These were very enthusiastically received by over 500 students.

Medals and Awards Committee

The following awards were made during 1982. The 1982 Rayleigh Medal was presented to Professor G B Warburton at the Spring Conference. The 1982 Tyn-dall Medal was presented to Dr F J Fahy at the Autumn Conference. The A B Wood Medal and Prize for 1982 has been awarded to Dr M J Buckingham but the presentation is not due to take place until April 1983. No Honorary Fellowships have been awarded in 1982. A new named lecture is to be instituted, to be known as the Stephens Lecture, in honour of the Institute's first President.

BRANCHES

North Eastern Branch

The year opened with an afternoon industrial visit to Bestobell Ltd, in January. As is usual for this type of meeting, the attendance was small but this did not detract from the interest shown and the general success of the meeting. The Branch A G M was held as usual in February and was followed by the customary snooker evening in the Newcastle Polytechnic Bar. The March meeting took the form of a full day technical meeting on the subject of Flow Induced Noise and Vibration. The meeting was well attended by about 30 persons, and this reflected the high level of general interest in the topic and the excellent set of speakers which had been assembled: the meeting was also a financial success. An Extraordinary General Meeting of the Branch was held on the same day at which the members formally accepted the revised Branch Constitution.

In an effort to make Branch activities available to as wide a section of its members as possible, two meetings were held outside the Tyneside area. The first of these was held at Darlington on Noise and the Environmental Health Officer. The second was on the subject of The Code of Practice on Discotheque Noise and was held at Carlisle. Both these meetings were well attended and similar venues will be arranged for the next session. The last meeting before the summer break was held in May at Durham. The meeting took the form of a visit to see The New Bells at Durham Cathedral followed by a social evening and buffet in a local hostelry. This was an extremely interesting visit and was well supported by the members. A meeting planned for October, in conjunction with the British Occupational Hygiene Society, on Hearing and Noise in Industry had to be cancelled because of poor response. The final meeting of 1982 took the form of a visit by about 20 people to Biddick Farm Arts Centre and a social evening. A local violin maker described his work in a very interesting manner and showed members around his workshop.

The year as a whole has been reasonably successful for the Branch. The committee has been particularly pleased to see the emergence of more Regional Branches in the country, wishes them well and looks forward to co-operation in the future.

North Western Branch

The first full year of existence for the Branch has been as successful as its first six months. A total of seven meetings were held, including the first AGM. It is a little disappointing that the average attendances were largely unchanged, although the enthusiasm of the regulars was undiminished. It is hoped to be able to fill vacancies on the Committee created by the retirement of two founder members by recruitment from colleagues in the industrial sector. In particular, the retirement of Mr R Atherton, one of the initiators, is a great loss.

Visits to the Pilkington Flat Glass Ltd (St Helens) and Mirrlees Blackstone Ltd (Stockport) were well attended, products of such diverse nature as glass and diesel engines being of both general and acoustical interest. Talks on Occupational/Industrial Noise Control, Noise Abatement Zones and Instrumentation Standardisation were given at the normal venue of Salford University; it is hoped during the next year to be able to hold meetings at alternative locations elsewhere within the north west area. The main social event of the year was held at a local hotel, where the assembled Branch members were treated to a discourse by Professor Peter Lord on the progression of his career to date.

Yorkshire and Humberside Branch

The Branch was formed at an inaugural meeting on 22nd September, 1981, when a working group was set up to investigate the prospects of a successful local activity in acoustics. Membership of the Institute from the region covered (North, West, and South

Yorkshire, and North and South Humberside) totalled 53 members at that time. The working group decided to seek the approval of members for affiliation as a Branch of the Institute of Acoustics, and this was approved at the General Meeting held on 10th December 1981. In the ensuing year, a total of five technical meetings have been organised:

10th December 1981 — The implications of EEC legislation for compulsory measurement of sound power of technical equipment — Don Baines, ICL Manchester. Evening meeting at Leeds Polytechnic. 20 participants.

4th March 1982 — White Finger associated with exposure to vibration of pneumatic chipping hammers — Bas Clarke, British Steel Corporation. Evening meeting at Sheffield Polytechnic. 11 participants.

18th May 1982 — BS 4142: Its usefulness as a measure of community response to noise — three guest speakers and open forum. Evening meeting at Leeds Polytechnic.

23rd September 1982 — Dealing with noise at Leeds/Bradford airport — Sean Quinn, Bradford MBC. Evening meeting at Leeds Polytechnic.

18th November 1982 — Practical implications of the Consultative Document on the protection of hearing at work — eight guest speakers. Full day meeting at Leeds Polytechnic. 45 participants.

Our current mailing list for meetings has grown to 72, and we have seen at least 65% of these people at the various meetings. It is hoped that we will be able to at least maintain this level of interest in the coming year.

South West Branch

The Branch has had a reasonably successful year, with the organisation of a number of small meetings. It still suffers from the major drawback that the total area covered by the Branch is large, but the membership is limited and spread over the entire area. By organising meetings in either Exeter or Plymouth, we manage to produce viable events, but always at a cost in terms of travelling time or expense to those living at the extremities of the region. As a consequence of this, small activity sessions tend to take place at the Cornwall Technical College, based upon the Diploma in Acoustics students, with the more ambitious meetings organised in the larger centres. One of these latter events was a visit to the Theatre Royal at Plymouth, where Mr Barnett of AIRO addressed us about the assisted resonance incorporated into the auditorium design. This was followed by attendance at a matinée performance, to allow an opportunity to evaluate the design achievements. Further short meetings, such as visits to the newly-built local radio stations, are scheduled for the near future.

Southern Branch

It has been a difficult year for the Southern Branch. Following the AGM last year, where the future of the Branch was left undecided and without a Chairman, it was resolved at the Extraordinary General Meeting in May, by the election of Ian Sharland as Chairman,

and a resolution that the Southern Branch continue. Nevertheless the meeting was sparsely attended, and meetings in general could still do with more support.

James Powell organised a successful 'Design and the Consultant' meeting at Portsmouth in February and the attendance and papers stimulated a good discussion, which was concluded reluctantly at the end of the day. Robert Weir's lecture on Vibration Measurements in Machine Monitoring in March was thinly attended but of great interest to those in attendance. John Pollard organised a successful and interesting tour of Westland Helicopters Ltd, at Yeovil, made jointly with a good contingent from the South West Branch.

The new season has got off to a slow start because of difficulties in finalising the programme. The visit to NPL, Teddington, was not well attended but the Schools' Sixth-Form Lectures were heard by about 100 people, and we appreciated Professor Peter Lord's demonstration of the latest digital recording and reproduction techniques and were fascinated by an ultrasonic view of Dr Peter Wells' interior.

Greater support from the Branch membership would be greatly welcomed.

London Evening Meetings

This year the London Evening Meetings have suffered the malaise that has afflicted some of the other Branches and Groups of the Institute in recent years — a shortage of people prepared to organise its activities. However, a rearguard action has been fought and a shortened series of monthly meetings is planned for the first half of 1983.

Hong Kong Branch

The formal inauguration of the Branch took place on 23 July 1982, attended by 14 Members.

At the inaugural meeting, it was agreed that evening meetings should be held at regular intervals, with topics to be chosen with the intention of being topical, practical and particularly relevant to Hong Kong. The first such meeting was held in November, with a talk on Noise in Hong Kong by Terry Willson (Principal Environmental Protection Officer, EPA). The meeting was attended by 21 members and their guests, including a number of overseas members who were passing through Hong Kong.

The Institute now has some 20 Corporate Members permanently resident in Hong Kong, and a survey of local companies has shown that 60 professional people have expressed interest in the activities of the Branch. The Branch expects to produce a full programme of technical meetings in 1983.

GROUPS

Speech Group

In 1982 the Group organised two technical meetings and the speech sessions at the Autumn Conference. The first was a full-day meeting on Speech Processing

and was held at RSRE, Malvern, in April. Eight papers were presented on many aspects of speech analysis and recognition. The second meeting was held at the University of Keele in July. Seven papers on Speech Processing in the Auditory System were presented. This inter-disciplinary meeting attracted contributions from neurophysiologists, psychologists, phoneticians and computer scientists.

The session on Speech Communication constituted a substantial proportion of the programme of the 1982 Autumn Meeting of the Institute of Bournemouth. About 20 papers were presented by authors from all over the country, plus a few from abroad.

Membership of the Group has increased during the year and currently stands at 54. The number of Corporate Members of the Institute is gradually increasing, and it is hoped that, in view of the new Constitution, this will continue.

Musical Acoustics Group

The Group's policy of holding visits and technical meetings has been pursued. The year began with a visit to the BBC Radiophonic Workshop and Maida Vale Studios, arranged through the kind offices of the Group Chairman, Professor Charles Taylor. The various techniques for electronically generating and manipulating sounds were in evidence, as well as a bewildering array of hardware — including the latest computer-controlled synthesiser. By contrast, the adjacent broadcasting studios gave an opportunity to see conventional music being rehearsed and recorded; the new studios under construction were of great interest.

Later in the year the Group was invited to the London College of Furniture for a tour of the Department of Musical Instrument Technology. The emphasis here was on craftsmanship, with traditional and modern skills being represented. Instruments of the violin, viola and guitar families were seen in various stages of construction, as were harpsichords, recorders and some of the more exotic baroque reed instruments. Piano repairing and electronic music also had a prominent place. This visit also provided a bait for the Annual General Meeting, enabling more than the usual handful of members to be present.

The major technical meeting of the year took place in May when a joint meeting was held with the Institute of Musical Instrument Technology, again at the London College of Furniture. Six papers were presented on a variety of subjects. These ranged from early keyboard actions through sound transmission in woodwinds and computer calculation of tuning temperaments in loudness distribution in ranks of organ pipes. The final papers described work on instrumental plate resonances from both theoretical and practical aspects, with particular reference to the guitar. The good interest and support enjoyed on previous similar occasions was much in evidence.

Building Acoustics Group

The year started with the circulation of the BAG Newsletter No 2, which set the scene for BAG — organised meetings during the year. The meeting on the Design and Use of Acoustics Test Rooms, after being postponed at the last minute due to a rail strike, was reconvened in September at Birkbeck College, London. It was well attended, with about 40 delegates listening to a selection of papers describing various working installations and recent developments. We were glad to welcome a contribution from Germany.

The international flavour was continued during a very successful three-day meeting, organised with the Musical Acoustics Group, on Auditorium and Electro-acoustics, held in Edinburgh. Contributions were received from both the USA and Europe, including psychoacoustics, room simulation, musical acoustics and practical examples of auditoria design. Invited lectures were delivered by Professor CA Taylor and Professor Anita Lawrence. Mr Brian Day gave a memorial address in honour of VL Jordan.

Underwater Acoustics Group

During the year, one major conference was organised. This was Spectral Analysis and its Use in Underwater Acoustics. It was held at Imperial College London over two days (29 and 30 April 1982). The technical content, organised by Dr Durrani of Strathclyde University, was of a high standard with 22 of the 30 papers coming from abroad. The meeting was a great success, attracting about 125 delegates.

It is the policy of the UAG to ensure that the full con-

ference proceedings are available in a bound form to delegates on arrival at a conference. This not only contributes to the usefulness of the conference but also provides a permanent record, maintains the academic standards, and through after-conference sales spreads the reputation of the IOA widely whilst also providing extra income. This policy has been successfully implemented for the six conferences held by the UAG since September, 1979.

The membership of the UAG stands at 77.

Industrial Noise Group

No meetings held.

Aerodynamic Noise Group

In abeyance.

ADMINISTRATION

Council wishes to acknowledge the vital contribution made to the successful running of the Institute by the Secretary, Mrs C M Mackenzie, and her assistants.

THE YEAR AHEAD

The central event of the coming year will undoubtedly be Inter-Noise '83. The major part of the organisational effort will, as usual, undoubtedly fall upon a relatively small number of people, aided by the headquarters secretariat. The Institute expects to gain much from this meeting, and Council urges members, in their turn, to give every possible assistance to those labouring on their behalf. Council wishes the organisers every success in this great undertaking.

THE MEMBERSHIP COMMITTEE of the Institute believes that the current number of Sponsor Members is lower than might be expected from the number of companies engaged in offering services or manufacturing acoustic products. The present total is 15. The committee also considers that this grade of membership is not widely known by industry and are about to embark on a campaign to promote members.

I ask for your support by:

1. encouraging your industrial/commercial contacts to consider becoming Sponsor Members and,
2. providing the Institute with a list of names and addresses of companies and organisations (including the name of the person to contact) whom you believe might be willing to join us.

The Committee would also be pleased to receive suggestions for improving and widening the appeal of Sponsor Membership. Please send names and addresses and/or suggestions to the Secretary who will then forward the appropriate 'Sponsor Membership Package' to possible applicants.

Many thanks for your support.

John Bickerdike, Vice President, Chairman of Membership Committee

MR ROY COLLINS

It is with deep regret that we have to inform advertisers, IOA Members and other readers of Acoustics Bulletin that our advertisement manager, Roy Collins, died recently after a short illness. Those who had contact with him in recent years will no doubt remember him as an efficient and friendly colleague and join us in mourning his premature passing.

H A Collins Ltd have appointed Roy's long-standing friend and colleague Mr Sydney Jary to act as Managing Director, and advertisers and readers alike may be assured of a continuing high standard of attention to their requirements under his direction.

Alison Hill

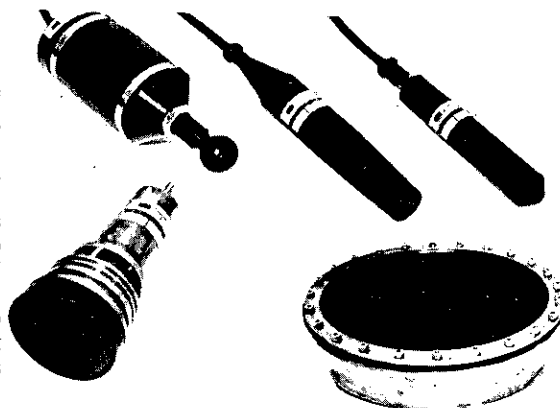
Correspondence and enquiries relating to advertising in the Bulletin should in future be addressed to:

Mr S Jary
H A Collins Ltd
28 Southway
Carshalton Beeches
Surrey SM5 4HW
Tel: 01-642 5775

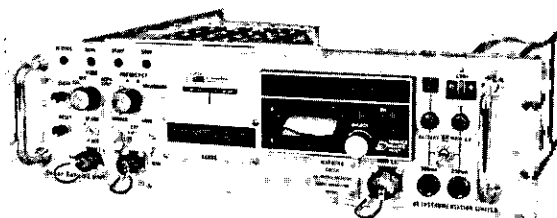


Electro-acoustic systems

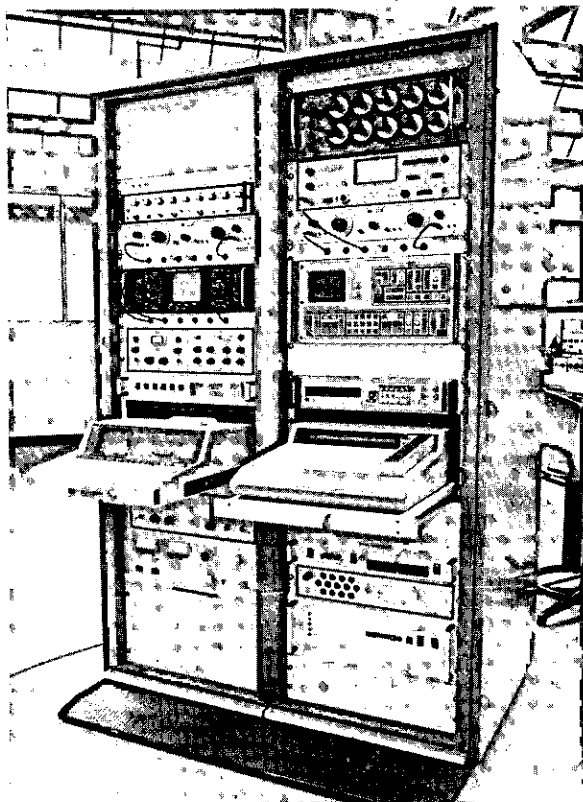
dB Instrumentation Limited's activities range from conceptual studies through design, development and manufacture to installation and commissioning of electro-acoustic systems and components. In this work, the company's experience covers the application of technologies as diverse as signal processing, data analysis, telecommunications, hydrophones and acoustic transducer systems. The company's products vary in complexity from simple low-cost components to high-technology systems. Special emphasis is placed on the development and manufacture of hydrophones, transducer arrays and instrumentation systems to exacting requirements and in small quantities. Current production of these devices and facilities covers frequencies from 0.1 Hz to 3 MHz extremely low level signal detection to transmitted powers up to 16 kW, omnidirectional transducers to beam widths of fractions of a degree. Systems include acoustic signal monitoring and analysis facilities, position-fixing track-ranging and equipments, and special-purpose test and calibration devices.



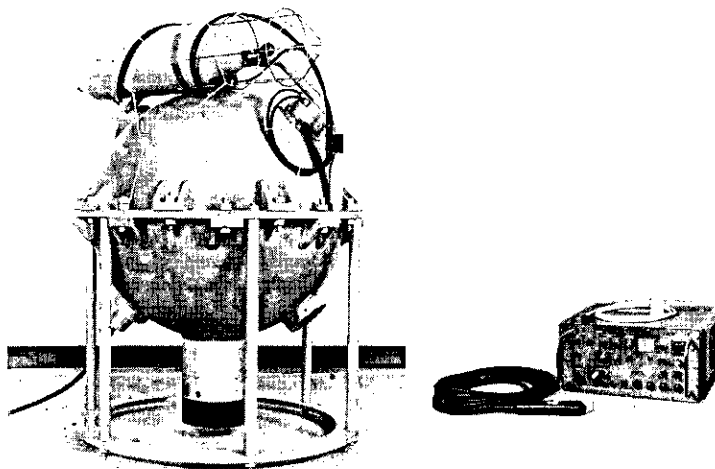
Hydrophones and electro-acoustic transducer components



Range and position-fixing signal processor



Automatic acoustic calibration system



Portable acoustic signal monitoring equipment

Specialists in Electro-Acoustic Engineering

BRANCH AND GROUP NEWS

North East Branch

A hasty re-arrangement for the January meeting had to be made when our visit to the BBC at Newcastle was cancelled because of their commitment to making programmes for Breakfast Television. However, the local commercial Radio Station came to our aid and a party of sixteen enjoyed a guided tour of the 'Metro' Studios.

At the AGM in February, Trevor Smith stepped down as Branch Chairman after several years service to be replaced by Chris Norris who previously served as Secretary. Ross Bainbridge has now taken over from Chris. The meeting heard that the Branch activities had been reasonably successful over the previous year and that the outlook was optimistic.

A half-day meeting on Planning and Noise was held at Darlington Town Hall in March. An audience of thirty-five heard presentations from Mr Atherton on Experiences with Environmental Noise in the Last Ten Years, Mr Owen on a Planner's Point of View and Mr Utley of BRE on Future Developments.

In April, the Civic Centre at Carlisle was the venue for another well attended meeting and again Richard Atherton took an active part. Jim Blair talked of his experiences in setting up a Noise Control Section for Glasgow City Council and B & K provided demonstrations of their latest equipment.

North West Branch

On the afternoon of April 20th 1983, nineteen members and guests accepted British Aerospace's invitation to enjoy a conducted tour of the Woodford factory which is part of the Manchester Division of the Aircraft Group, in the company of Bernard Chidley and John Evers, both IOA members and fully occupied in the Acoustics Department at Woodford.

The production of the HS 748 Airliner in both civil and military versions, the production of the AEW Nimrod and the refurbishment of existing Nimrods were shown, and members who had travelled from the Local Authorities, Universities, Private and Public Companies in North Lancashire, the Wirral, Greater Manchester and Cheshire all benefited greatly from their experience.

In particular, the development of the ATP HS 748 and HS 146 was discussed together with the difficulties experienced in reducing internal noise and vibration within air frames and conducting Noise Certification testing.

In addition, members were shown the basic engineering skills taught in the 'training school' and practised in 'Assembly' on how existing and new materials were riveted, bonded or fixed.

The conducted tour was an opportunity to learn at first hand about the design, production and use of modern aircraft and generated much interest and thought in the members who attended.

Musical Acoustics Group

The Musical Acoustics Group has been rather quieter than usual and unfortunately the proposed joint meeting with the Catgut Acoustical Society in July has had to be postponed because of Catgut's other commitments. It will now take place in October.

The Group is involved in the organisation of the IOA Spring Conference at Swansea in April 1984. Contributions are invited on any topic in Musical Acoustics and should be sent to:

Dr B Richardson
Physics Department
University College
Cardiff CF1 1XL.

Speech Group

The following meetings are planned for the Group.

15 July: Speech Perception. Institute of Hearing Research, Nottingham.

7 October: Speech Telecommunication. Standard Telecommunication Laboratories, Harlow.

December: Temporal Aspects of Speech. University of Cambridge.

Further details are available from the Secretary, R K Moore of RSRE, Malvern.

There will be a whole-day meeting of the Industrial Noise Group on Thursday 20 October 1983 at ICI, Welwyn Garden City. The theme of the meeting will be Noise Emission from Industrial Fans.

For further details call the Secretary to ING, Andrew Corkill, on Welwyn Garden 23400. □

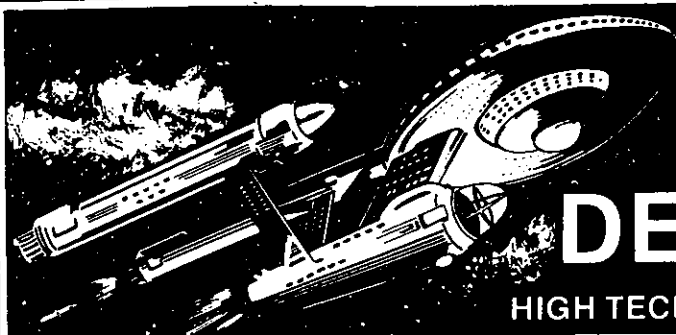
New Standards Director for BSI

Dr Ivan Dunstan has been appointed Standards Director of the British Standards Institution. From 1972 to 1974 Deputy Director (Resources) of Warren Spring Laboratory, Dr Dunstan subsequently became Director of Materials Quality Assurance in the Ministry of Defence Procurement Executive, which has responsibility for research on materials, development of test methods and drafting of specifications leading to Defence Standards. In 1979 he became Director of the Building Research Establishment at Garston, Watford. In his new post with BSI Dr Dunstan will be responsible for the technical aspects of BSI's national and international standards programme, which covers some 8500 standards projects. □

Acoustics and the Sea-Bed

A conference organised by the Underwater Acoustics Group and held at the University of Bath, 6-8 April 1983

This was the first time that the Underwater Acoustics Group had organised a conference with such a title. The response was extremely gratifying for the organisers and especially for the delegates (135) who found themselves partaking in a conference of wide scope and with representatives from a large number (10) of overseas countries. As the abstracts of all 52 papers presented at the conference were published in the last issue of the Bulletin readers are referred to that for details of the papers. However, in summary, the contributions fell mainly into the following four subject areas: acoustic properties of sediments; acoustic scattering from the sea-bed; acoustic propagation; interface waves. For each subject area, invited papers provided current perspective and were supported by a number of contributed papers covering specific research topics. In addition Dr D E Weston gave the Presidential address on *The Influence of Bottom Profile on Ocean Acoustic Propagation*. A special event was the delivery of the A B Wood Memorial Lecture by M J Buckingham who chose as his title *Acoustic Propagation in a Wedge-shaped Ocean*. The conference proceedings were available as usual for delegates on arrival. □



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To find more and to obtain an early interview, please telephone FRED JEFFRIES C.Eng MIERE in complete confidence on HEMEL HEMPSTEAD (0442) 212655 during office hours or on (0442) 49909 evenings or weekends (not an answering machine). Alternatively write to him at the address below.

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Third International Conference of Photoacoustic and Photothermal Spec- troscopy.

Paris, April 5-8, 1983

This third meeting was intended to provide an interdisciplinary forum for the interchange of knowledge of this fast-growing field and to indicate clearly its unique features as compared with other experimental techniques. The meeting was held at the Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, which last year celebrated its hundredth anniversary. The creation of the Institute was guided by two main ideas; firstly the combination of physics with chemistry and secondly the development of a broad practical outlook arising from investigations carried out in its laboratories. These have been extraordinarily rich in their association with notable scientific

discoveries such as that of Paul Langevin and ultrasonic generation, of Joliot and Irene Curie and artificial radioactivity, of the isolation in 1898 of polonium and radium by the Curies etc.

The Meeting was divided into seven sessions of approximately three and a half hours each with a free period on the afternoon of April 7. Typically each session comprised a 45-minute period of one or two tutorial lectures followed by a coffee and poster-viewing break of one hour and then one or two oral presentations. A session was finally concluded with a one-hour panel discussion on the various contributions. Just over one hundred posters were submitted with twelve oral presentations and the same number of tutorial lectures.

Considerations of space prevent specific attention to individual contributions but the titles of the various sessions will provide a good indication of the breadth of the subjects discussed. These were: Physical Aspects and theory of photo-acoustic and photothermal detection; Opaque systems (absorbing or diffusing); Experimental Methodology; Surfaces and Interfaces; Photosynthesis and relaxation processes; Thermal waves and non-destructive control; and Weakly absorbing systems.

The organisers are to be congratulated on having abstracts (up to three pages each) available at the time of the meeting. Fuller manuscripts are to be published as the proceedings by the Journal de Physique, Europhysics Journal. Those interested in the subject and who were not among the 180 registrants will therefore have an opportunity to bring themselves up-to-date with recent advances. □

RWBS

New Products

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

Dual Channel Signal Analyser B & K type 2032

The 2032 has 801 line resolution in either single or dual channel mode and it has Real Time computing speeds of 5 kHz in dual channel mode or greater than 10 kHz in single channel mode. Its dynamic range is typically 80 dB and the incorporated input amplifier attenuators cover the range 15 mV to 100 v peak in 3 dB steps, with autoranging when required.

All measurement results on the 2032 are shown in continuously updated form on a 12-inch CRT screen and they can be shown with a choice of many different formats, including Real, Imaginary, Nyquist, Magnitude, Phase, or Nichols. The total frequency range of the instrument is from DC to 25.6 kHz, and this can be subdivided into 15 smaller bands anywhere within the range. A further enhancement of the display is provided by a zoom facility having a zoom factor of up to 16384.

The selectable functions available from the 2032 include Sound Intensity, Frequency Response, Cross Correlation, Impulse Response, Autospectrum, Cross Spectrum, Auto Correlation,

Coherence, Non-Coherent output, Coherent output, Cepstrum and Liftered Spectrum.

Precision Integrating Sound Level Meter B & K type 2230

This new integrating sound level meter from Brüel & Kjær is a Type 1 precision instrument intended for all kinds of sound level measurements including octave and third octave frequency analysis with the aid of snap-on filter-sets.

The 2230 carries out five measurements in parallel: SPL, Max, Min, Leq and SEL, all of which can be obtained from the same signal. A choice between 2 detector modes (RMS and Peak), 3 time weightings (Slow, Fast, Impulse), 4 frequency weightings (A, C, Lin and ALL pass) is available for the measurements.

Measurements are displayed on a 4-digit liquid crystal display. Further details from Brüel & Kjær (UK) Ltd, Cross Lances Road, Hounslow, TW3 2AE. Tel: 01-570 7774.

Sound Reducing and Fire Door from ICI

Two colour technical data sheets issued by ICI Acoustics give details of new high performance sound reducing and fire door products. Marketed under the tradename SELSHIELD, both the 'SR

Acoustic Door' and 'FR Fire door' ranges combine robust welded steel construction with elegant distinctive styling to provide equipment which is ideal for application to problems in a wide variety of situations — factories, offices, hotels, hospitals etc.

Currently available in four single and double leaf sizes, the SR doors offer an acoustic performance of over 40 dB Sound Reduction Index, whilst the FR doors — manufactured in four single leaf sizes — are rated at up to 2 hours fire resistance and achieve 22 dB SRI.

Data sheets are available from ICI Acoustics, Rosanne House, Bridge Road, Welwyn Garden City, Herts AL8 6UF or telephone Mr Ray Rogers, 07073 23400 Ext 7401.

Norwegian Electronics Real Time Analyser type 830

The type 830 is a dual channel real time analyser with two independent channels having a frequency range of 1 Hz – 10 kHz for dual channel operation extending to 20 kHz for single channel operation. This instrument has an 80 dB dynamic range and uses digital TRUE RMS signal detection. The 1/3 octave spectrum produced from digital filters may be combined to give 1/1 octave spectrum. The measured levels can be displayed in terms of Leq, Lmax or SPL (Fast, Slow or Impulse response).

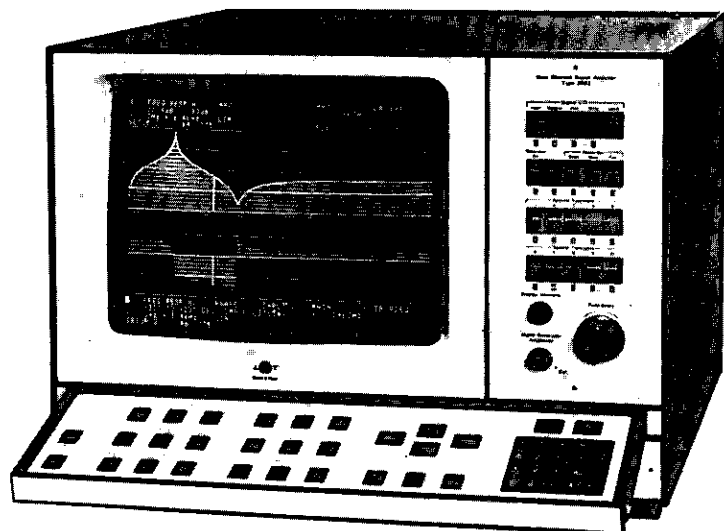
A mini-floppy disc drive has been built into the 830 so that the user can handle the large amount of data associated with real-time analysis. By connecting the Sound Intensity Probe type 216, the Real Time Analyser is converted to a direct reading Sound Intensity Analyser.

Further details are available from Gracey & Associates, Threeways, Chelveston, Northants NN9 6AJ. Tel: 0933 624212.

Ono Sokki range of Spectrum Analysers

The Ono Sokki range of real-time spectrum analysers are being marketed in the UK by CEL Instruments.

The CF 300 is a portable FFT analyser with a 96 Kbyte mass memory storage, the CF 500 a Dual Channel FFT Analyser, the CF 410 a Tracking FFT Analyser and the SD 142 a Stress Frequency Analyser.



DUAL CHANNEL SIGNAL ANALYZER
Type 2032/2034

Airport Noise Monitoring

A new 8-page brochure is available from CEL describing the CEL 200 Environmental Noise Monitoring System which is primarily intended for installation around airports.

Further information from CEL Instruments, Computer Engineering Ltd, 14 Wallace Way, Hitchin, Herts SG4 0SE. Tel: 0462 52731.

Anechoic Chamber Catalogue

G+H Montage have published a new catalogue describing in detail their Anechoic Chambers for Industry and Research Centres.

G+H Anechoic Chambers are available in the UK through their distributors

Designed for Sound Limited, who supply and install not only the acoustic materials but also the ventilation systems of the chamber.

Copies of the catalogue are available from Designed for Sound Ltd, 59-61 High Street, Wivenhoe, Essex.

Ear Protection without isolation

With Castle-Microair Loop Broadcast System, people working in noisy areas wearing specially adapted ear-defenders can be kept 'in touch' through broadcasts transmitted over a loop wire. Thus paging calls, staff information, fire warnings and safety alert tones can be broadcast despite a high level of background noise.

The system consists of an AF loop amplifier Model GA80 which is fitted with a good quality radio and paging microphone. A broadcast wire is fitted around the walls or across the ceiling of the noisy workshop and plant area, and connected to the amplifier. People operating within the broadcast loop area wear ear-defender headsets which contain a small receiver unit and ferrite-rod aerial which picks up the broadcast transmitted over the loop wire.

Further details from Castle-Microair Ltd, Unit 1, Hogwood Lane Industrial Estate, Finchampstead, Wokingham, Berkshire RG11 4QW. Tel: 0734 730050. □

Book Reviews

Acoustics and Noise Control

B J Smith, R J Peters and S Owen

Longman 1982

236 pp £9.95

This book contains an updated version of the material in a previous book by the first-named author, together with three new chapters on vibration, noise control engineering, and the law relating to noise. Also added are appendices containing definitions of acoustical terms, some teaching experiments, and a bibliography. It is aimed at students on architecture and building first degree and higher diploma courses and also candidates for the Institute of Acoustics Diploma.

The first chapter is a short one about basic ways of measuring sound and the units that are used. It seems a pity that though sound intensity is introduced here, no descriptive definition of it is given and the formula shown, without any comment, is that applicable to plane waves.

The second chapter discusses the ear and the subjective perception of sound. Whilst the text is generally clear there are some rather odd things in some of the figures. One that illustrates the frequencies and sound pressure levels of common sounds implies that a bass singer can get down to about 32 Hz (ie three octaves below middle C) and that the soprano range is some four octaves higher than the bass range. It is also a pity to find quoted in a book of this kind that '7 Hz is particularly unpleasant' when discussing infrasound.

The next chapter deals with room acoustics, and this is followed by one on structure-borne sound. An indication of the sometimes uneven level of treatment of different subjects is that here we find the wave equation for longitudinal waves in a thin rod derived, partial differentials and all, whilst nowhere else in the book is calculus used at all. The wave equation is not even mentioned in the context of airborne sound, the topic of the following chapter.

Criteria for such things as ear damage risk; speech interference; noise levels in buildings, on construction sites, and concerning motor vehicles are next discussed: then there is a chapter on vibration. The chapter on noise control engineering discusses sound radiation and characteristics of sound fields, vibration isolation, sound insulation, and ventilating system noise, together with some control strategies. The final chapter summarises the legal position regarding noise in English law, including nuisance, the Control of Pollution Act, the Health and Safety at Work Act, as well as various other Regulations and Acts.

The selection of experiments is a useful set illustrating the use of common noise measuring devices and some of the more commonly made acoustical measurements.

My initial reaction to the book was favourable, but this was later tempered by irritation at some of its shortcomings. At the end of each chapter there is a set of questions — an excellent thing in a text book — but in quite a number of cases the information needed

to answer some of the more basic of them is not presented until a later chapter. There are more editorial/proof reading faults than there should be, and some of the figures have the wrong captions. These are the sorts of thing that don't disturb unduly someone who already has a fair grasp of most of the material before reading the book, but are likely to be frustrating to those at whom the book is aimed. It is a useful book, but a complete rewrite, rather than partial adaptation of an earlier book, would probably have produced something of more even quality.

S J Flockton

Noise Control, Principles and Practice

Brüel and Kjær 1982

156 pp

This book is based on a publication of the Swedish Workers Protection Fund. Its object is to make industry and industrial employees aware of safety and of an improved and safer working environment. Among a number of different subjects covered in the original publication, one area is the effects of and reduction of noise. Brüel and Kjær has extracted from this book the particular subjects of noise and the guide to instrumentation for noise measurement. There are 156 pages in the book, three quarters of which are illustrated with drawings showing vivid descriptions of noise and methods of noise control.

The book is divided into three sections. The first of these describes how noise

affects man both physically and psychologically. Sound waves, frequency, decibels, octave band filters, structure-borne sound, resonance, sound insulation, sound absorption, reflection and transmission are explained in plain language. Part two describes a wide range of sound level meters, a digital cassette recorder, statistical noise analyser and bandpass filters. Part three is devoted to the theoretical and practical aspects of noise control. Many useful, yet simple, methods of controlling noise produced by factories, pneumatic drills, airconditioning and turbulence noise are clearly illustrated.

This book conveys the most essential information on noise, its sources and the receiving end through the medium of illustrations which portray the true reality of the subject devoid of excessive elaboration. Perhaps the greatest difficulty in writing a book of this kind is to determine what to include and what to omit. It will be of great value not only to industrialists, engineers and architects, but also for anyone who wishes to enter this field of study for their basic understanding of the principal aspects of acoustics. ☐

Y K Zaw

NON-INSTITUTE MEETINGS

1983

4 - 7 September. *4th Conference of the British Society of Audiology*. London. Contact: Mr M C Martin, 105 Gower Street, London WC1E 6AH.

5 - 9 September. *IUTAM/IUGG Symposium on Sea-Bed Mechanics*. Newcastle upon Tyne. Contact: Prof B Denness, School of Marine Technology, The University of Newcastle upon Tyne, Newcastle upon Tyne NE1 7RU.

5 - 10 September. *IUTAM Symposium on Turbulence and Chaotic Phenomena in Fluids*. Kyoto, Japan. Contact: Prof T Tatsumi, Dept of Physics, Kyoto University, Kyoto, 606 Japan.

October. *22nd Acoustical Conference on Electroacoustics and Signal Processing*. Contact: Dr I Januska, Czechoslovakia Academy of Science, Provaznicka 8, 11000 Prague 1, Czechoslovakia.

15 - 20 December. *Sixth IFTOMM Congress on Theory of Machines and Mechanisms*. New Delhi, India. Contact: Department of Mechanical Engineering, Indian Institute of Technology, New Delhi 110016 India.

1984

12 - 13 January 1984. *Design against Wind-induced Failure*. Bristol. Contact: Judy Vare, Conf Sec, PO Box 63, Guildford, Surrey GU2 5BH.

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

SEE Publications

The IOA and SEE, as part of their policy of collaboration between the two organisations, endeavour where possible to co-operate on meetings programmes. IOA Members may be interested to know of the proceedings of relevant meetings currently available.

Realistic Fatigue Testing (1969)	£2.00
Dynamic Testing (1971) Vols 1 & 2	£5.00
Vibration Isolation (1972)	£2.00
Marine Environment (1973)	£2.00
Vibrations in Environmental Engineering (SEECO 73)	£2.00
Specialist Techniques in Fatigue Testing (1974)	£2.00
Statistical Aspects of Fatigue Testing (SEECO 75)	£2.00
Fatigue Testing & Design Vols 1 & 2	£5.00
Environmental Engineering Aspects of Pollution Control (1978)	£2.00
Vibration, Shock & Noise (SEECO 79 Vol 1)	£5.00
Vibration, Shock & Noise (SEECO 79 Vol 3)	£5.00
The Measurement & Control of the Shock, Noise & Vibration Environment (SEECO 82 Vol 1)	£6.00
The Measurement & Control of the Shock, Noise & Vibration Environment (SEECO 82 Vol 3)	£6.00
Fatigue in Engineering Applications (SEECO 82 Vol 5)	£6.00
Digital Techniques in Fatigue (SEECO 83)	£12.00
SEE Handbook (SEE Members Price: £7.00)	£10.00

Prices quoted do not include Postage & Packing. The publications are available from the SEE Secretariat at Owles Hall, Buntingford, Herts SG9 9PL. Tel: Royston (0763) 71209. ☐

NEW ELECTIONS

At its meeting on 25 May 1983, Council approved the following elections.

Member

P A Atkinson	P Hepworth
S A Beard	J M Houldsworth
R A Beck	B R Nagle
C F Chow	P R Quemby
M K Cogger	N C Rotheroe
J A Duffield	J W Smith
M J Green	M Tohyama

Associate

W H Alajeel	M A Kenyon
M N W Austin	D J Mackenzie
D P Elliott	J R Nedwell
S A K Fiaxe	J R Wilson

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:

Local Government Noise Problems and Construction Industry Noise

3 October 1983

Meeting Organisers: Mr S Turner and Mr P T Freeborn
Scientific Branch, Room 705, Greater London Council, The County Hall,
London SE1 7PB

(200 word abstracts required)

Studio Design for Radio and Television

7 November 1983

Meeting Organiser: Mr N Spring
Sandy Brown Associates, 6 Fareham Street, London W1V 3AH

(200 word abstracts required)

Sonic Emission

December 1983

Meeting Organiser: Dr R W B Stephens
Department of Physics, Chelsea College, Pulton Place, London SW6

(200 word abstracts as soon as possible)

Spring Conference—Acoustics 84

10-12 April 1984

Chairman of Organising Committee: Professor B L Clarkson FIOA,
University College of Swansea, See p 16 for Session Organisers

(400 word abstracts by 1 October 1983)

Diploma in Acoustics and Noise Control

Award Ceremony of Prizes at the Colchester Institute, 11 May 1983

A pleasing and informal ceremony was arranged by David G Bull, the senior lecturer in the School of Mechanical and Production Engineering, and Peter Allaway presented the project prize to S Whitehead of St Edmondsbury District Council for the excellence of his project entitled *Noise as it affects the Rural Community*.

The IOA prize for all-round excellence at the 1982 examination was presented by myself to Mr A Carruthers of British Telecom Research Laboratories. Both the prize recipients received their training at the Colchester Institute. Also in attendance were representatives of their employers, and the industrial and local authority members of the advisory panel to the courses in acoustics, noise and vibration control held at Colchester. Through the hospitality of the Colchester Institute in arranging a lunch in its own catering department the opportunity was provided for discussion amongst the members of the audience.

The proceedings were terminated by a visit to the noise control laboratories where the strong emphasis on practical work was illustrated by a number of demonstrations. The Colchester Institute is fortunate in being able to utilise the special facilities of local companies engaged in acoustical work, which now number at least fourteen (including the Wolfson Unit for Research and Development in Active Noise Control). The area is becoming known as the 'acoustics valley'.

David Bull is to be warmly congratulated on his initiative in arranging the gathering which I hope will provide a pattern for the future. □

RWBS

Material for the July issue of Acoustics Bulletin should reach Mrs F A Hill at 25 Elm Drive St Albans, Herts AL4 0EJ, no later than Friday 26 August.

Systems Engineers to £16,000

The projects are at an early stage of development and offer considerable scope for initiative and career advancement for high calibre people.

Our Client, an acknowledged Leader in Underwater acoustic technology now requires Systems Engineers, applied mathematicians and physicists to work on a major new project and to develop further business areas.

Specific openings are available in:—

SYSTEMS ENGINEERS (1) — Development of computer simulation models to predict performance and operational characteristics for various scenarios of the total system.

SYSTEM ENGINEERS (2) — Develop and use computer models in the study of Acoustic arrays, Underwater Acoustic environments and Signal Processing Systems.

TRIALS ANALYSIS — Planning of trials, carrying out simulation runs and liaising with software development.

ALGORITHM DESIGN — Design of Algorithms for processing systems. Knowledge of Artificial Intelligence an asset.

THEORETICAL STUDIES — To lead a team of systems engineers engaged in Signal Processing, Underwater Acoustics, Systems Analysis, simulation and mathematical analysis of weapon systems.

TRANSDUCER DESIGN — Design and evaluate transducer elements and Arrays, and use computer models to assess performance.

Candidate requirements:—

Degree or better in Maths, Physics, Computer Science, Engineering.

Experience in Acoustics, Sonar, Weapon Systems, Hydrodynamics, Signal Processing, Computer Systems, Simulation, Real Time programming.

If you have relevant experience and would like to work in a young and dynamic environment then please contact John Spencer at the address below or send a detailed CV.



Skyquip Technical Services Ltd.

85 High Street, Winchester, Hampshire. SO23 9AP Tel: Winchester (0962) 69478

Specialist recruitment for Aerospace, Defence & Communications Industries

UNIVERSITY OF SALFORD

NEW APPOINTMENTS

Applications are invited for the following specially funded posts on the full-time staff of the University tenable from 1 October 1983. The emphasis initially will be on research activity although lecturing duties will also be allocated. Candidates should be aged 35 or less; starting salary will be within the scale £6375 — £13505 (under review) with USS benefits.

LECTURER IN ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS — REF ME/375/AB

This appointment is in the Department of Aeronautical and Mechanical Engineering. The successful applicant would be expected to identify potential application areas for Expert Systems Techniques in the general area of Manufacturing Systems. Applicants should have a good Honours degree and possibly a higher degree, in an appropriate engineering or science discipline.

LECTURER IN ELECTROACOUSTICS OF SOUND FIELDS — REF AA/2/AB

This appointment in the Department of Applied Acoustics is intended to broaden the existing acoustical expertise. Applicants should have experience in electronics and transducer design together with a working knowledge of acoustics. A higher degree and proven research ability in a relevant field are desirable.

Application forms and further particulars are available from the Registrar, University of Salford, Salford M5 4WT (tel: 061-736 5843 ext 215), to whom completed applications quoting the appropriate reference number should be returned as soon as possible.

Cranfield

Research Officer

Acoustic Signal Processing

An opportunity has arisen for a well-qualified engineer to join a team working on acoustic signal processing. The post is in the Signal Processing and Applications Group, which provides a contract research and consultancy service for a wide range of industries. The Group has extensive testing and recording facilities for data acquisition and is particularly concerned with the application of analysis techniques to the solution of noise and vibration problems.

A degree and relevant experience in acoustic measurement and analysis techniques or in practical signal processing would be an advantage, and an interest in electro-acoustics would be particularly desirable.

The appointment, initially for one year, will carry a salary in a range rising to £8,085 or, possibly, £11,105 per annum, depending on age and experience.

Informal enquiries about the work may be made to Andy Tomlinson on Bedford (0234) 752769. For an application form and further information, please contact: The Personnel Department, Cranfield Institute of Technology, Cranfield, Bedford MK43 0AL. Tel: Bedford (0234) 750111, ext. 3336.



Institute of Acoustics Meetings

1983

October	MAG(P)	Joint Meeting with Catgut Acoustical Society	Chelsea College, London
3 October	M	Local Government Noise Problems and Construction Industry Noise	London
7 October	SG	Speech Telecommunications	Harlow
13 October	M	Noise-induced Hearing Loss. Joint Meeting with British Society of Audiology	London
2 November	M	Practical Use of Active Noise and Vibration Control. Joint Meeting with Institution of Mechanical Engineers	London
7 November	BAG	Studio Design for Radio and Television	London
December	M(P)	Sonic Emission	Chelsea College, London

1984

13-14 March	M	Speech and Audio Tape Analysis for Police Use	Birkbeck College, London
10-12 April	M	Acoustics 84—Spring Meeting	Swansea
4-6 November		Autumn Conference	Windermere

Key:

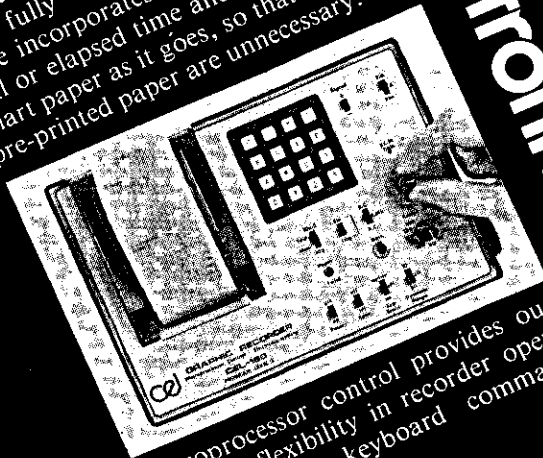
M = Meetings Committee Programme
(P) = Provisional
MAG = Musical Acoustics Group
SG = Speech Group
BAG = Building Acoustics Group

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

Microprocessor Control and Electronic Writing

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

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



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

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

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



GRAPHIC RECORDER
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CEL-160
PROGRAM LEVEL 2

