Acoustics Bulletin

January 1986 Volume 11 Number 1

INSTITUTE OF ACOUSTICS

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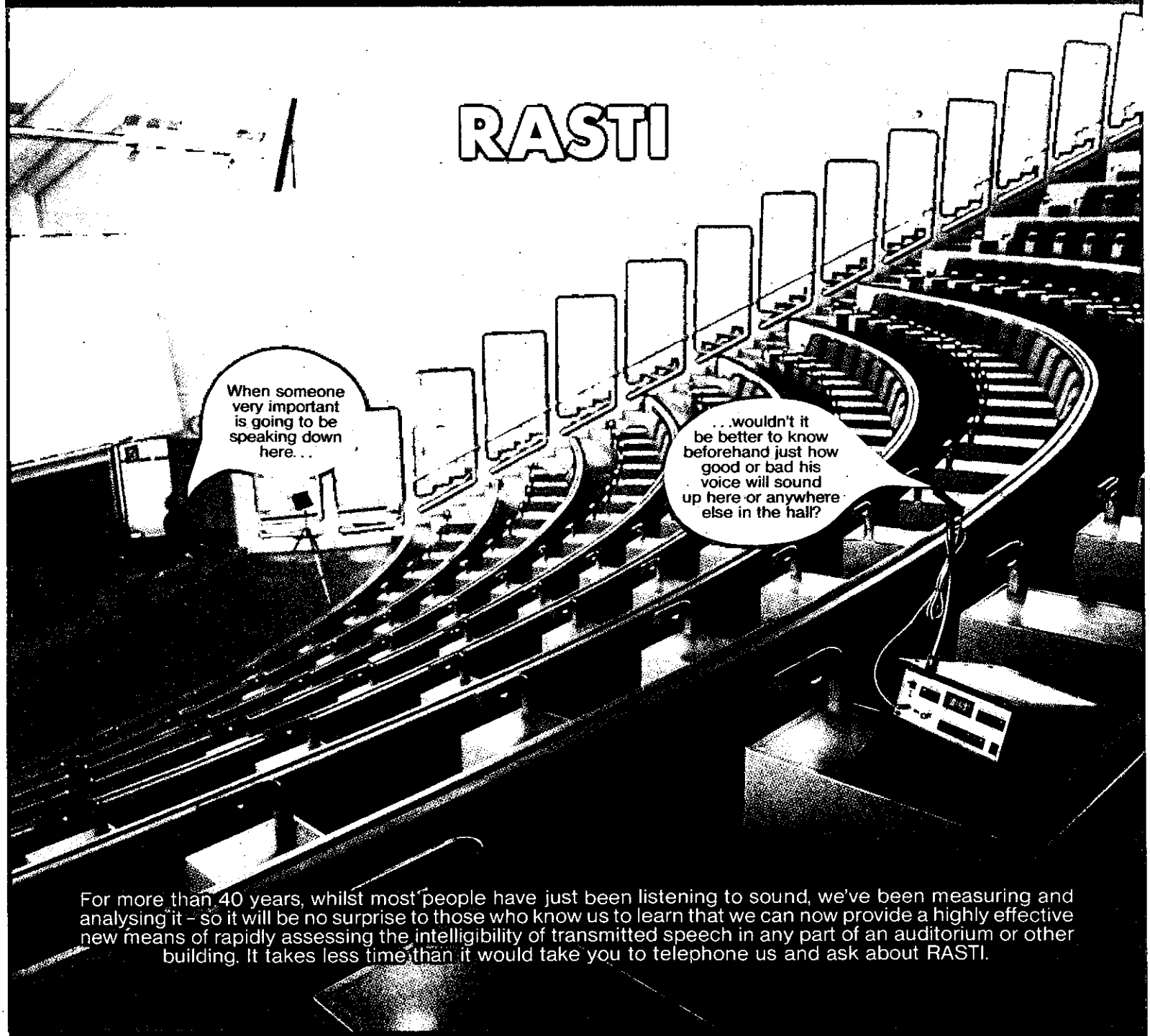

For more than 40 years, whilst most people have just been listening to sound, we've been measuring and analysing it – so it will be no surprise to those who know us to learn that we can now provide a highly effective new means of rapidly assessing the intelligibility of transmitted speech in any part of an auditorium or other building. It takes less time than it would take you to telephone us and ask about RASTI.

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Editor:
F A Hill

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

Advertising enquiries to:
Sydney Jary Ltd
28 Southway
Carshalton Beeches
Surrey SM5 4HW
Telephone: 01-642 5775

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

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

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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

Dear Member

It is pleasing to be able to report further progress in two important areas.

Noise Council

Our discussions with the Institution of Environmental Health Officers have led to an agreement to form a joint Council. At the time of writing, further discussions are being held with the Institution of Occupational Safety and Health (IOSH). It is expected that they will also become a founding member of the Council. This will bring together the three main UK professional bodies concerned with noise, having a combined membership of about 12,000. It is planned to launch the Noise Council early in 1986.

Engineering Council

Following the visit to the Institute last August, the Engineering Council has now produced guidelines to the steps we must take to become a nominated body. The main points are:

(a) To set up an identifiable division with a measure of devolved authority in relation to nomination.

(b) Develop criteria for training and experience as appropriate for the grades of registration (CEng and TEng).

(c) Produce training guidelines for the use of applicants and employers.

(d) Define educational requirements for nomination for CEng and TEng.

Council is dealing with these matters.

The Institute has a new Honorary Treasurer. Ralph Harrison was unable to continue and resigned in October. His place has been taken by Geoff Jackson, who is also Chairman of the Building Acoustics Group.

We thank Ralph for his period of office and welcome Geoff into what many consider to be the most difficult job in the Institute!

PS See you at the Spring Meeting at Salford, April 7th-10th. I will try and get to your paper.

Yours sincerely

Geoff Leventhall

NAMAS, NATLAS, BCS and EEC

What is NAMAS?

NAMAS is the National Measurement Accreditation Service, which is concerned with the accreditation or formal recognition of laboratories as being competent to perform specified types of measurements on particular classes of instruments, products and materials. NAMAS is operated from the National Physical Laboratory, a research establishment of the Department of Trade and Industry (DTI), and accreditation by NAMAS represents official Government recognition of a laboratory's competence. This accreditation is widely accepted throughout the public and private sectors but the principal reason for the establishment of NAMAS is to improve international recognition of the UK measurement industry at all levels. Indeed, it is hoped that this will eliminate the need for UK export products which have been calibrated or tested in accredited UK laboratories to be retested in the country of destination.

There are two wings of NAMAS: the British Calibration Service (BCS), which accredits laboratories for calibration, and the National Testing Laboratory Accreditation Scheme (NATLAS), which accredits laboratories for other types of tests. Around 150 laboratories have already been accredited for calibration (BCS) and 250 for other types of testing (NATLAS), but the demand for accreditation continues to grow.

Eligibility for membership

NAMAS is a scheme open to all competent laboratories performing objective measurements based on properly-documented measurement procedures or specifications; NAMAS does not accredit laboratories for subjective testing or for providing professional opinions. The scheme includes independent commercial laboratories, and also laboratories which are part of larger organizations such as manufacturers, government departments, public bodies, research and educational establishments; it operates no matter whether they offer a measurement service to outside customers or only to those within their parent organizations.

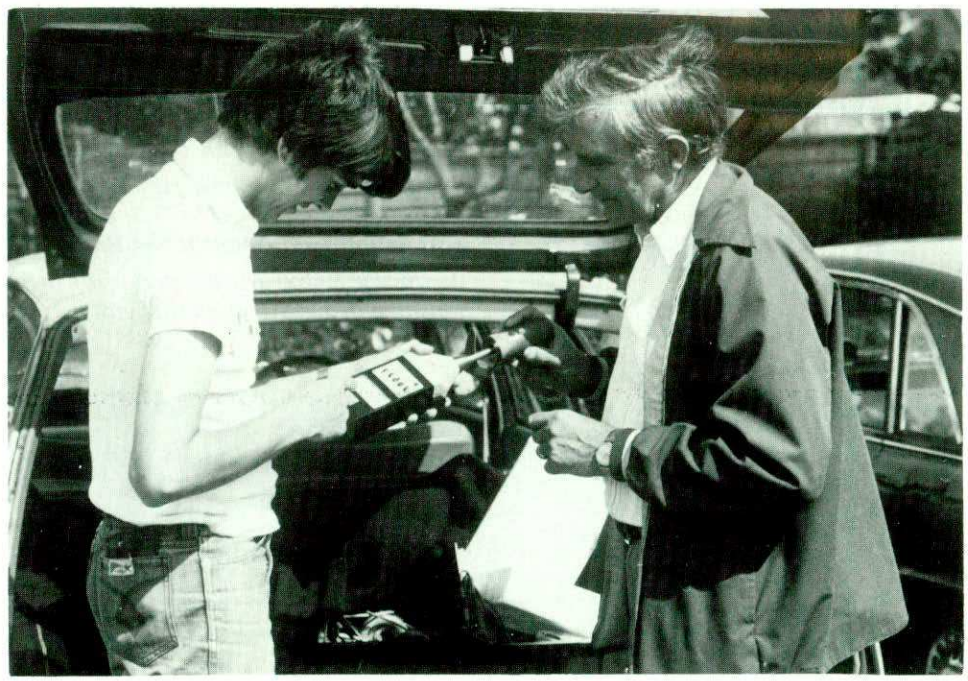
Laboratories are assessed against formal written criteria relating to laboratory organization, staff, equipment, calibration and measurement procedures, and laboratory documentation including records and reporting. Following accreditation, all laboratories are subjected to regular monitoring to ensure that their level of performance remains satisfactory; additionally, calibration laboratories are required to participate in audit exercises. All accredited laboratories have to demonstrate that their measurements are traceable to the national measurement standards, many of which are held by NPL. Testing laboratories are generally expected to use BCS-accredited laboratories to establish such traceability.

Importance to acoustics

To date, several acoustical testing laboratories have been accredited by NATLAS and one acoustical calibration laboratory by BCS, but several more are currently applying for accreditation and a rapid increase in numbers is expected. This is due to the fact that, from March 1986, new EEC Directives become effective which specify the permitted sound emission levels from construction plant and equipment, such as power and welding generators, concrete breakers and picks, and tower cranes. UK suppliers will be required to obtain EEC type-test approval for their plant and equipment if they are to continue selling them within the EEC. The DTI is in the process of approving bodies to conduct such testing in accordance with the Directives, and these are required to hold NATLAS accreditation for the tests concerned. The tests involve determining the sound power emitted by the equipment when operating under specified conditions on a flat open site, the sound pressure level being measured at a number of points over an imaginary surface containing the equipment.

New calibration procedure for EEC tests

The EEC Directives require the noise measurement system to comply with IEC 651:1979 *Sound Level Meters*, Type 1 (identical with BS 5969:1981, Type 1). This standard contains a prescription only for full type test of the sound measuring system and does not detail regular recalibration procedures. As several noise measurement channels may well be needed to deal with a test object as large as a tower crane, the requirement is for a relatively simple (and therefore inexpensive) calibration procedure which can, nevertheless, provide a high degree of assurance that the measurement system is performing correctly. It so happens that a revision



For accurate noise measurements a calibrated sound-level meter and sound calibrator are required

of BS 3539:1962 *Sound Level Meters for the Measurement of Noise Emitted by Motor Vehicles* is in progress. This specifically covers the calibration and verification of performance of Type 1 meters and constitutes an appropriate basis for the EEC tests. This document has already reached the 'Draft for Public Comment' stage, but is not expected to appear as a British Standard until well into 1986. Due to the urgent need for traceable calibrations for the EEC tests, NPL has already started a fixed-fee calibration service which accords with the present draft. Once the revised British Standard is published, it is hoped that acoustical calibration laboratories accredited by BCS will take over this work. However, in the longer term, the growth in legislation dealing with noise emission may demand a more general treatment of requirements for regular calibration of noise measurement systems.

If you require more information on any of these topics, please contact the Acoustics Branch, Division of Radiation Science and Acoustics, National Physical Laboratory.□

Michael Delany

INSTITUTE MEDALS 1987

Rayleigh Medal

The Rayleigh Medal is awarded, without regard to age, to persons of undoubted acoustic renown for outstanding contributions to acoustics. The medal is normally awarded to a United Kingdom and to a foreign acoustician alternately. A suitable citation accompanies the presentation of the medal to the recipient. As a condition of the award, each recipient is required to give a presentation in a suitable form to the Institute, of an acoustical topic of his interest. The 1987 Rayleigh Medal will be awarded to a foreign acoustician.

A B Wood Medal and Prize

Nominations for the 1987 A B Wood Medal and Prize will be made by the Acoustical Society of America.

Anyone wishing to put forward the name of a foreign acoustician for consideration by the Medals and Awards Committee as the recipient of the Rayleigh Medal should write in strict confidence to the President before the end of March 1986. A brief outline of achievements and relevant publications should be included in support of the nomination.□

IOA Awards 1986

The Rayleigh Medal for 1986 has been awarded to Professor E J Richards HonFIOA, of ISVR, Southampton. The A B Wood Medal and Prize go to Dr P D Thorne, MIOA, of the Institute of Oceanographic Sciences, Taunton; both Professor Richards and Dr Thorne will give their award Lectures at the IOA Spring Conference in Salford in April. The recipient of the Tyndall Medal for 1986 is Mr J G Charles, FIOA, of Bickerdike Allen Partners, who will give his Lecture at a later date.

The 1986 RWB Stephens Lecture will be given at the Spring Conference 1986 by Professor H Kuttruff of the Institut für Technische Akustik, Aachen, Federal Republic of Germany.□

Live Aid — Noise and Acoustic Aspects

Jim Griffiths MIOA
Greater London Council

On the 13th July 1985, Live Aid was born, an historic event unlikely to be repeated or rivalled. The nature and size of this event required detailed and extensive planning, albeit in an extremely short time scale. The GLC being the Licensing Authority for pop concerts held at Wembley Stadium had regard for the safety, health and welfare of those attending the concert. Within these areas of responsibility, the Scientific Services Branch of the GLC was employed to monitor and control the noise emission from the concert. The acoustician then, would be concerned with the acoustics in the stadium, the environmental noise pollution and the noise exposure of members of the audience.

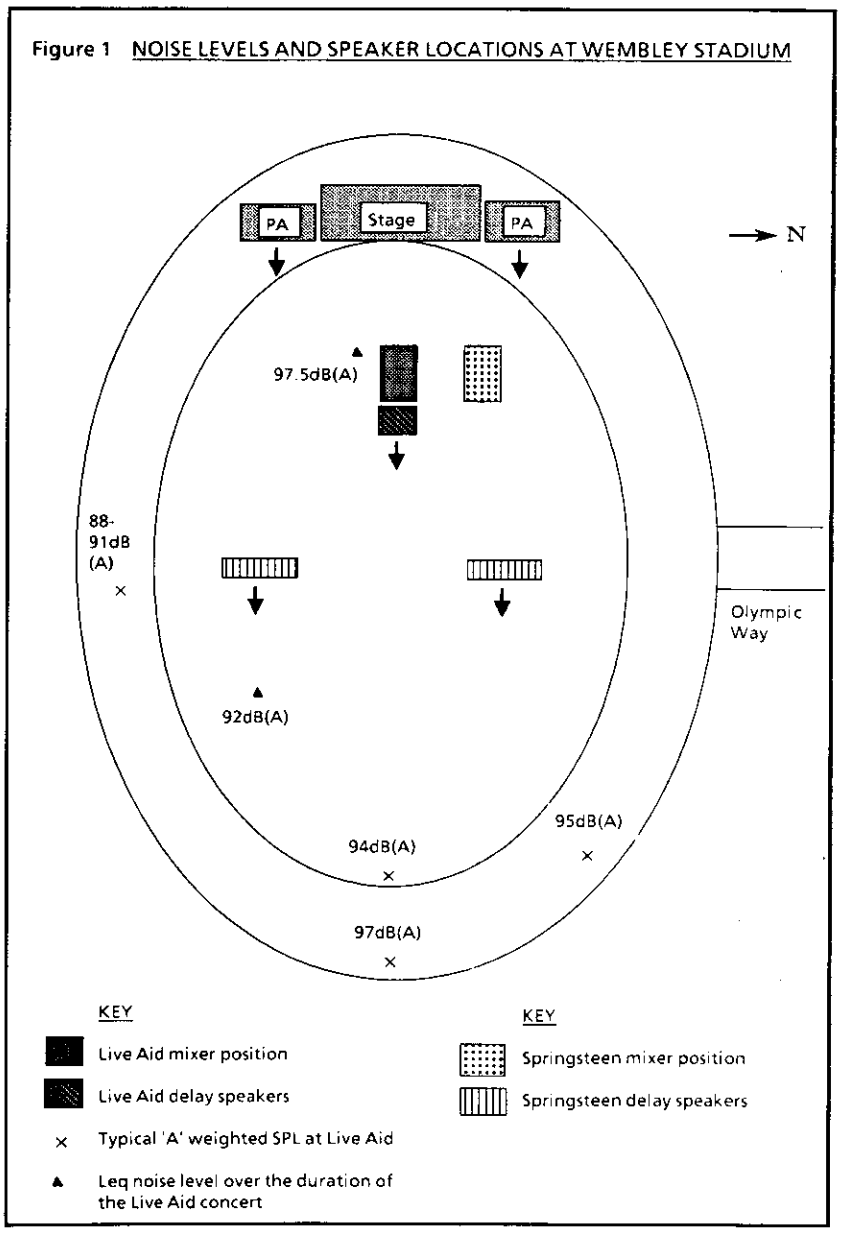
Wembley Stadium is renowned for its poor acoustics, in particular the poor sound propagation to the middle and latter parts of the field. The large distances and many hard reflecting surfaces in the stadium give rise to delayed reflections and hence disturbing echoes in many areas, especially when the sound source is positioned solely at one end of the venue. The audience further affects the sound, especially at high frequencies where there is high attenuation due to the grazing incidence of sound over the heads of the audience.

The PA company (Malcolm Hill Associates) providing the sound system was therefore faced with a number of acoustical problems, let alone the logistic problems of an event of this scale. These included satisfying the BBC requirements, obtaining adequate and reliable electrical supplies and having at best only ten minutes between each performing band. The PA system, specially designed to handle the frequency/dynamic range requirements of popular 'live' music, consisted of 52 cabinets positioned either side of the stage. To cut corners because of the lack of time, no delay speaker towers were initially installed to overcome the poor sound propagation. Delay towers had been successfully employed a week earlier at the Bruce Springsteen concerts, where two speaker towers were suspended above the audience halfway down the stadium. The sound check the day before the Live Aid concert highlighted the inevitable poor sound distribution in the rear areas of the field, and a delay tower was hurriedly erected in the evening, 130 feet from the stage behind the mixer tower (figure 1).

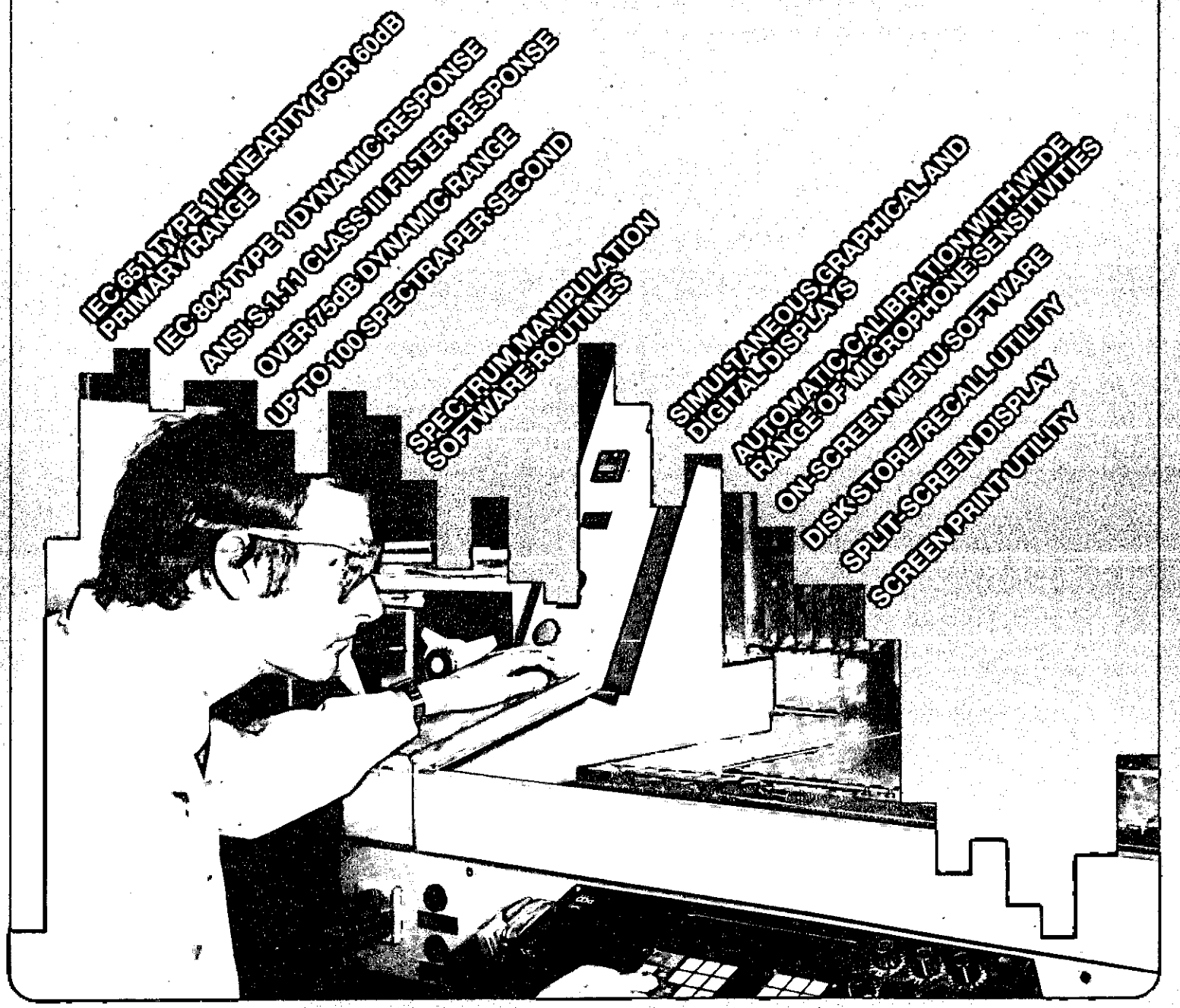
However, it does not pay to cut corners, as on the day of the concert the delay tower proved to be too small and ineffective. This was borne out by a survey carried out by Richard Vickers of Kelsey Acoustics, who obtained the opinions of eleven sound engineers at the concert. The subjective responses indicated that the sound was poor at the backfield, marginally better in the midfield and fairly good at the mixer position. These views were confirmed by our objective measurements which showed a large variation of noise level (of the order of 9 dB(A)) between various stadium locations.

As well as establishing effective sound distribution and sound quality for the majority of the audience; it was essential to limit the noise exposure of members of the audience and environmental noise disturbance in the local community. The environmental noise pollution problem was further exacerbated by the activities of the previous week, when three pop concerts had been held at the stadium, causing local residents to complain about the noise. Fortunately, the nature of Live Aid was likely to make residents more tolerant of the noise almost irrespective of the absolute noise level.

Figure 1 NOISE LEVELS AND SPEAKER LOCATIONS AT WEMBLEY STADIUM



CEL 8000
REAL TIME FREQUENCY ANALYSIS SYSTEM



CEL 8000 REAL TIME FREQUENCY ANALYSIS SYSTEM

A real time true third octave frequency analyser and data management system that is designed to operate with a CBM personal computer. The instrument is available in two versions:

CEL-8010 Single channel 20Hz-20kHz.

CEL-8020 Sixteen channel multiplexed input, 2Hz-20kHz and self-contained random noise generator.

Software is provided with the CEL-8010 to allow operation with the CBM 8032, 8096 or 8296 computer and with the CEL-8020 to allow operation with the CBM 8096 or 8296 computer.

This innovative approach achieves true laboratory standard performance, with the benefits of microcomputer flexibility at a fraction of the cost of dedicated analyzers. In addition a user-friendly operating environment has been created which offers considerable flexibility in spectrum archiving and spectrum manipulation.

Technical Description

There are two main hardware elements: the CBM computer and, secondly, the filter set which contains up to 46 channels of filter, RMS detector and analogue to digital converter. In the CEL-8020, a frequency range of 2Hz to 20kHz, plus 'A', linear and hand-arm vibration paths is supported with each channel meeting the requirements of the relevant international standards. Each channel comprises a 6-pole Chebyshev charge coupled filter and in order to achieve high noise immunity, for each octave there is a 4-pole anti-alias filter and a 3-pole clock residue filter on each third octave filter. The output of each filter feeds a true RMS detector circuit which minimises filter settling time and ensures that accurate sound level samples can be read rapidly by the A-D converter. Each channel output level is described as an 8-bit word which permits a resolution of 0.3dB in the displayed data. Every 10 msecs a special handshake is able to transfer a complete spectrum to the digital interface of the CBM computer, where it is displayed or processed.

The CBM 8000 computer series has a proven record in controlling scientific instruments under IEEE 488 protocol. Using special hand-shake software very rapid data transfer from the filter set is obtained over this parallel bus. Additionally, existing disk-based software enables the computer to be used for other tasks.

System Software

A split screen approach ia used to simultaneously accommodate primary and secondary task displays, thus ensuring that screen prompts are always available to the user. In the lefthand screen window, the parallel channels which constitute the real-time spectrum are displayed on an 80dB display axis, whilst in the righthand screen window the main function menu is displayed. In order to provide a friendly user environment, within the menu driven software a simple question and answer format has been adopted which ensures that operation of the system can be quickly learned.

Primary Task Software

One-third octave band spectra can either be displayed with the amplitude axis uncalibrated in dB relative to a full-scale of 0dB, or in calibrated dB using the calibration menu option. By simply responding to questions concerning microphone sensitivity and calibration level, the display is correctly annotated and microphone sensitivities of 3mV/Pa, 12.5mV/Pa, 35mV/Pa, 50mV/Pa and 100mV/Pa are accommodated.

The display range may be selected from 40dB or 80dB, according to the application and up to 55dB of gain can be selected in 5dB steps to set the measurement range.

A further menu page permits selection of either channel peak hold, exponential averaging with 125 msec, 1 sec and 10 sec time weightings, or linear averaging of up to 4096 spectra. Linear averaging further allows independent spectra to be taken with a variable delay between successive spectra, of between zero delay and 10 secs.

Secondary Task Software

In the case of a conventional real-time third octave analyzer further processing or simply multiple spectrum storage and recall would require a separate computer and appropriate software.

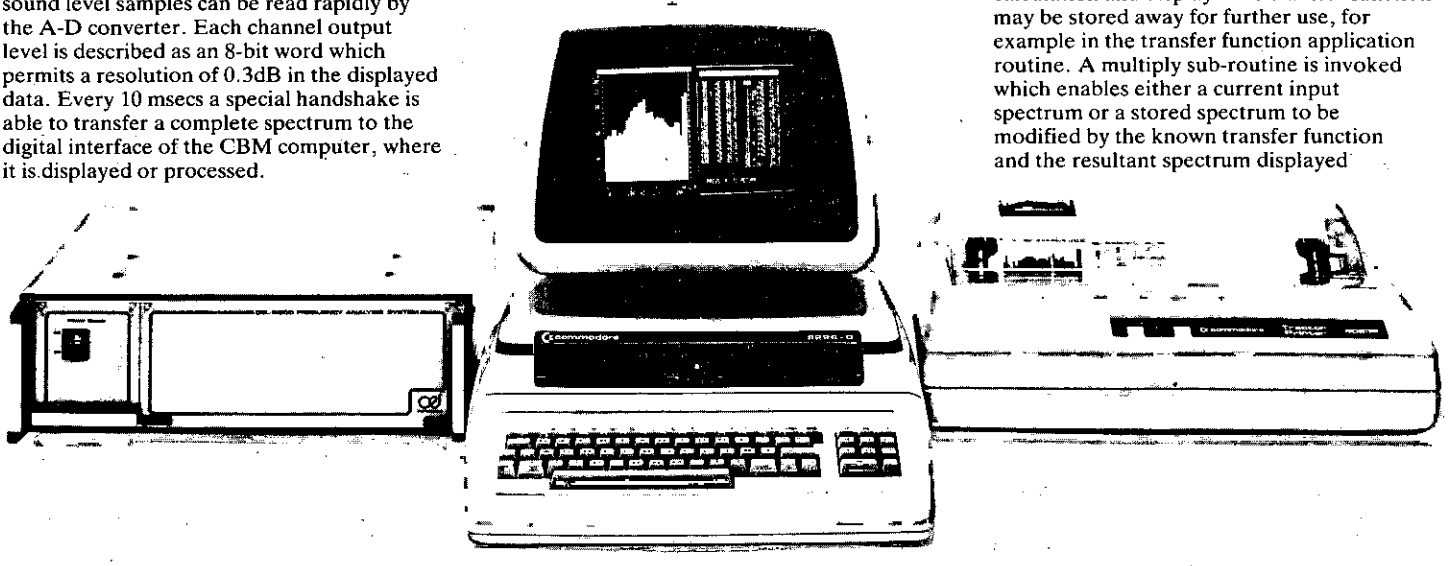
The CEL-8000 system provides several secondary processing tasks under the main menu heading: STORE/RECALL, which makes extensive use of the disk utility.

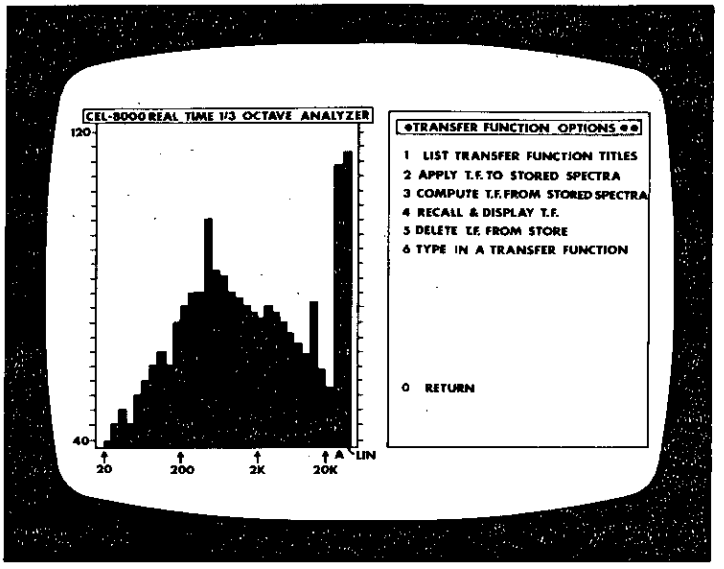
Single Spectrum Operations

This menu option enables spectrum files to be labelled, stored and recalled. The utility supports writing and reading to CBM dual disk drives, thus enabling easy permanent storage of data. Recalled spectra are fully annotated and can be simultaneously displayed in graphical and digital form, whilst a cursor can be employed for individual channel identification. A further option from this menu allows a spectrum to be multiplied by a constant, which will be of particular benefit for weighting spectra or for averaging combined spectra in sound power calculations.

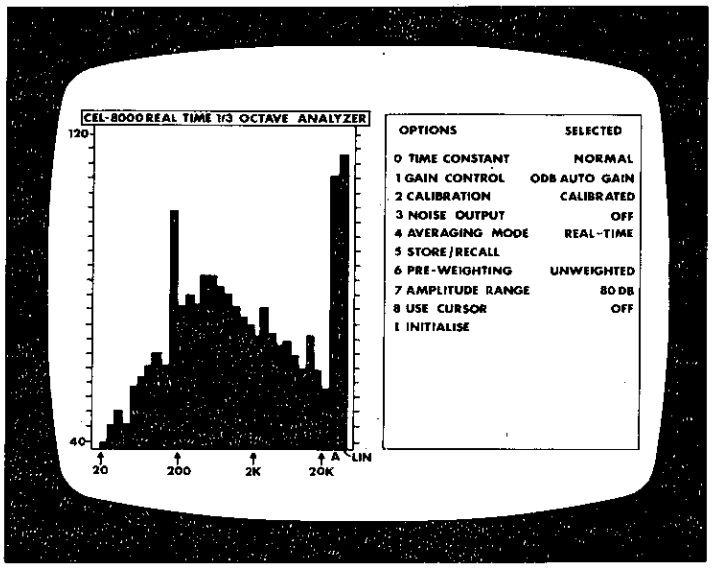
Transfer Function Operations

Within this utility the calculation of a transfer function from two spectra stored on the disk can be undertaken simply by naming the spectra: a search and automatic load is undertaken followed by transfer function calculation and display. The transfer function may be stored away for further use, for example in the transfer function application routine. A multiply sub-routine is invoked which enables either a current input spectrum or a stored spectrum to be modified by the known transfer function and the resultant spectrum displayed

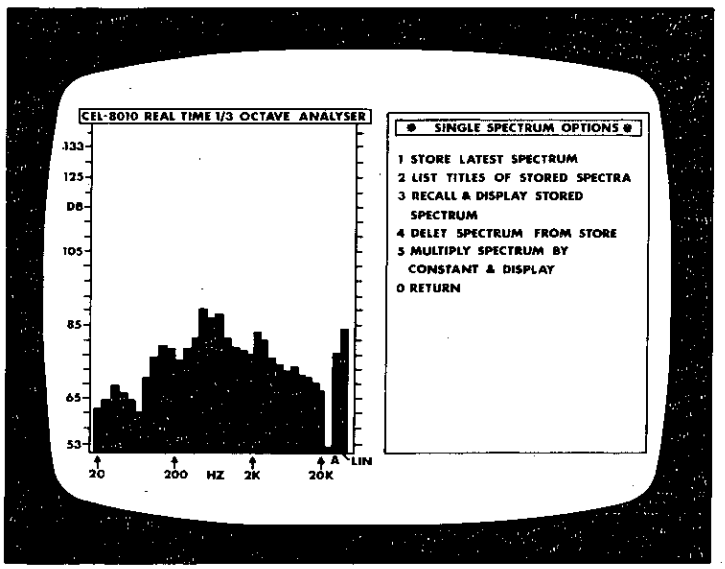




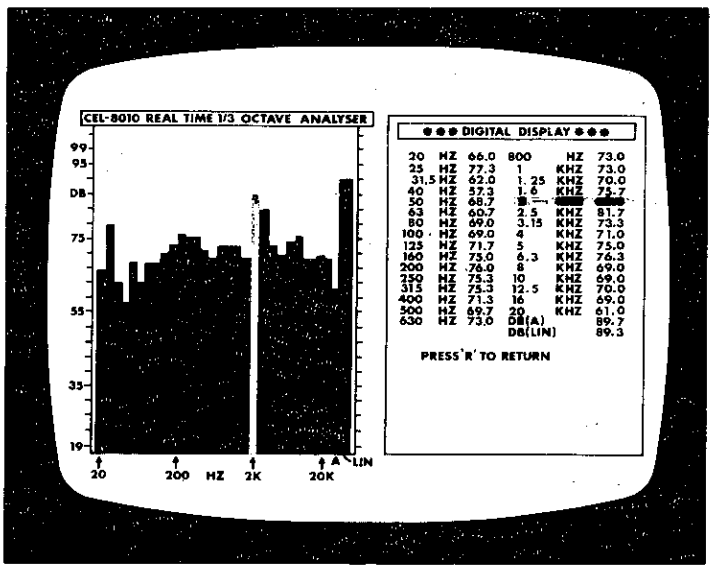
Transfer function menu display



Typical screen display illustrating split screen and main options menu



Single spectrum options



Digital display

and/or stored.

Instead of calculating a transfer function from known spectra, the utility also enables a keyboard entered transfer function to be used for spectrum manipulation.

Combination Operations

The routines which are supported by the transfer function menu are arithmetic multiply and divide functions. However, also of considerable benefit in acoustics are power addition and power subtraction functions.

Selection of this menu option enables two or more spectra to be combined using an arithmetic add subroutine, or two spectra may be combined using the arithmetic subtract subroutine. This latter function will be particularly useful correcting spectra for background noise for example, whilst the spectrum combination facility will permit direct sound power calculations.

Combined spectra may be stored on the disk for further processing under the other option menus.

Printing Results

When spectra have been averaged or have been subject to secondary processing the resulting display may be hard-copied using a CBM 2022, 4022, 8023 or 1361 printer, by invoking the print utility from the main menu. The width of each printout is A4 size and is ideal for direct inclusion in reports which could be constructed under the various proprietary word processing programmes available for the CBM computer.

INSTRUMENTS

Specification

Input Section

No of Channels	1 channel CEL-8010, 16 multiplexed channels CEL-8020.
Input Signals	Direct input from CEL-165/3 preamplifier or direct line input using suitable cables from conditioning amplifiers, tape recorders, etc. 200V microphone polarization supply provided.
Measurement Range	Total measurement span of 135dB giving coverge of −1dB to 134dB using CEL-192 microphone subject to self noise limitations. May be extended to −7dB to +156dB by use of alternative microphones or attenuators. Frequency range 0.2Hz to 75kHz (2kHz-75kHz on 8010 version).
Calibration	Automatic calibration is possible with 3, 12.5, 31.5, 50 and 100mV/Pa microphones. Manual calibration offsets ±3dB.
Overload	Analogue or ADC overflow on Lin channel
Self Noise	Maximum of −83dB re FSD depending on band centre frequency.
Gain Control	Automatic or manual ranging over 55dB in 5dB steps.

Analysis Section

Number of Analysis Channels	35, CEL-8010. 46, CEL-8020
Centre Frequencies	20Hz-20kHz, CEL-8010. 2Hz to 20kHz CEL-8020. Plus Linear (Impulse), A (Impulse), A, Linear and hand-arm broad band weightings (no hand-arm on CEL-8010).
Filter Standardisation	Third octaves to IEC-225 and ANSI S1.11 class III. Broadband weightings to IEC 651 (ISO-5349 for hand-arm. CEL-8020 only).

Detector Section

Detector Type	True RMS integrated system.
Dynamic Range	80dB (nonimal). Primary range to IEC 651 Type 1 to −60dB FSD. Maximum error ±2.5dB at MSD.
Time Constants	A and Lin 35 msec, FAST, SLOW, & IMPULSE. Hand-arm filter - 10 seconds (8020 only).
Pulse Duty Factor	>63dB as per IEC-804, Type 1.
A-D Conversion	Resolution of 0.3dB.

Interface Section

Protocol	Modified IEEE 488 to increase the data transfer rate. Data transfer mode allows 10ms per spectrum. Control mode allows full IEEE-488 control

Software Section

Time Constant	Selects hardware detector time constants for A and Linear channels
Gain Control	Selects 0-55dB fixed gain 5dB steps.
Calibration	Permits direct amplitude scaling for a range of microphone sensitivities
Averaging Mode	Selects real time mode, peak hold mode, exponential averaging mode of 125msec, 1 sec or 10 sec exponential time contstants or linear averaging mode of between 1 and 4096 spectra with selectable delay between successive spectra.
Store/Recall	Selects secondary processing and disk utility with either single spectrum operations, transfer function operations or spectrum combination operations.
Pre Weighting	Selects 'A' Weighting on or off
Amplitude Range	Selects either 40dB or 80dB display
Use Cursor	Selects cursor function on or off
Shift/tab	Invokes print utility with selection of either CBM 2022, 4022, 8023 and 1361 printers. Three screen prints per A4 page.
Multiplex (8020 only)	Individual channel selection or sequential channel selection of up to 16 channels.

Noise Generator Section (8020 only)

Source	39 stage digital random sequence generator.
Repetition	>4 hours.
Frequency Response	5Hz - 50kHz ±3dB.
Output level	0.5V rms (white).

General

Weight (excluding CBM parts)	10kg.
Dimensions (excluding CBM parts)	46cm x 42cm x 16cm.
Power Supply	230/115V, 50/60Hz.

The manufacturers reserve the right to amend any of the information given without prior notice in order that they can take advantage of new developments.

Ordering Information

Part number CEL-8010 describes the 20Hz to 20kHz filter set, whilst part number CEL-8020 decribes the 16 multiplexed channel 2Hz to 20kHz filter set complete with integral random noise generator. Units are supplied complete with power cord, IEEE to CBM connecting cable, two copies of the program disk and a single data disk.

Part number CEL-8000 K1 describes a complete system comprising:

CEL-8010	Real Time, Third Octave Analyser
CBM 8296	Computer
CEL-177	Precision Acoustic Calibrator
CEL-165	3X Preamplifier (less accessories)
CEL-192F	Measurement Microphone
CEL-4440/5	CEL-165/3 to CEL-8000 cable - 5m
CT3	Instrument Tripod

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Lucas Group Companies

Detailed noise guidelines are published in the GLC Code of Practice for Pop Concerts, designed to minimise both the risk of hearing damage and noise disturbance. Having regard for these guidelines and previous measurements recorded in the stadium, we calculated that an Leq noise level of 100 dB(A) at the mixer position (130 feet from the speakers and at a height of 8 feet) for the duration of the concert, and a maximum one minute Leq of 103 dB(A) would satisfactorily meet the noise criteria. The noise levels were specified at the mixer position so that an active form of noise control could be adopted throughout the concert. Noise monitoring equipment was installed on the mixer and made clearly visible to the sound engineer. This enabled any likely increase above the guidelines level to be immediately noticed and remedied.

The use of the monitoring equipment at the mixer desk and the co-operation of Mike Scarf (Chief Sound Engineer) enabled the specified noise limits to be met, and the Leq noise level for the concert duration was 97.5 dB(A), well within the specified noise criterion. A fair balance between the 'gamekeeper's level' and the 'poacher's level' seems also to have been achieved, with Vicker's survey showing that roughly half the engineers were satisfied with the level of sound. The highest Leq noise level over the duration of a performance (typically 20 minutes) was 100.7 dB(A) (the band Queen) and the lowest Leq noise level was 90.5 dB(A).

On the whole, the concert was an outstanding success on all grounds including noise. The aim of the concert was achieved, the sound level was acceptable for most of the audience although those at the rear area of the field may not agree, the level was acceptable to limit the noise exposure and acceptable to the residents with no reported complaints. Even at the end of the day, environmental noise disturbance was not forgotten, the power of the PA system transmitting the words of the organiser 'please leave safely and quietly'.□

Material for the April issue of Acoustics Bulletin should reach Mrs F A Hill at 25 Elm Drive, St Albans, Herts AL4 0EJ, no later than Friday 14 February.

A British Standard for Noise Barriers

In response to a request from the Department of Transport, supported by the County Surveyors Society and the Timber Research and Development Society, a BSI committee has been constituted to draft Part 15 of BS 1722 to be titled *Fences and barriers for the attenuation of noise*. This is intended to specify performance requirements for fences and barriers for the attenuation of noise, including stability under wind loading, as well as acoustic requirements.

Although the document will deal primarily with road noise it is expected to be useful for other applications. The main materials being considered at present are timber, concrete and steel.

No draft is available at present but the committee would welcome comment from persons with particular knowledge or experience to contribute.

For further information please contact: Mr F C Rattue, Secretary to RDB 34/12, at 2 Park Street, London W1A 2BS, or Tel: 01-629 9000, Ext. 3316.□

BRANCH AND GROUP NEWS

North West Branch

Members of the North West Branch visited Pilkington Glass of St Helens early in October. The visit started with a tour of the float glass plant developed by Pilkingtons; this process revolutionised the production of flat glass. The glass is produced in a continuous process starting with the huge furnace. The inside of the furnace was viewed through thick smoked glass, giving a rare view of powerful heat injecting jets of flame. The resulting molten glass continuously flows out of the furnace onto a lake of molten tin. Under carefully controlled conditions of temperature and atmosphere the glass is gradually cooled until it solidifies. The annealed glass is then automatically cut and stored. Any glass not satisfying the rigorous quality control is rejected. The plant has highly automated cameras monitoring each stage; it operates continuously 24 hours a day all year round. Only a handful of operators are required to run the entire process. This is very different from the old pre-float process where 5 ton pots of glass were rolled and polished to produce flat glass; this was very labour intensive.

Following the tour and light refreshments, members were given a presentation by Roy Seneschall and Cliff Inman. Roy gave an overview of Pilkington's design and development philosophy in producing an integrated high performance product. Increasingly the company is happy to work to customer specifications supported by Pilkington's own research and development. Cliff Inman discussed the acoustic and thermal performance of various types of glazing and illustrated some of the better units available, rounding off an instructive and entertaining afternoon. I recommend a visit to the Glass Museum if you are in St Helens; entrance is free and it is open most days.

C Waites

Five days after Father Christmas and his sleigh had been installed on a lofty perch high above Manchester Town Hall as part of the City's Christmas lights, Members of the North West Branch met within the other seat of Local Government in the City, County Hall, to hear Karl Pratt of Vibronoise-vibration & noise consultants based in Cheadle, Cheshire — give a presentation entitled **Vibration factors in the design of foundations for large reciprocating machines.**

This interesting and practical presentation given on November 12th discussed the main object of limiting amplitudes of vibration to satisfy British Standard requirements, customer specification requirements and the maintenance of the environments of sensitive adjacent buildings. Karl identified his purpose of estimating dynamic loading in deference to static loading, its association with soil mechanics and tackling the key problem of establishing dynamic impedance. Three methods of computing impedances were discussed and published results of soil profiles, foundation base shapes and embedments were evaluated.

Block resonance test methods used in practice were explained and how the dynamic modulae for the soils concerned could be back-figured. A case history relating to the installation abroad of three gas compressors driven by electric motors and each having a mass of 122 Metric tonnes was then given, illustrated by slide photographs taken on-site. A brief question and answer period then followed, concerning the economic value of safe conservative design and the use of epoxy grouting for stakes embedded in the ground from which vibration measurements could be taken.

It is not certain what Father Christmas, in his very large inflatable form, thought of this in his elevated position but Members who passed him on their way home after post-meeting alcoholic refreshment may have a more practical understanding of damping large structures, something which may have particular local significance if strong atmospheric winds affect Santa between November and Twelfth Night.

John Dinsdale

Southern Branch

The **AGM** of the Southern Branch, postponed from 4 December 1985, will now take place on 19 February 1986 in the Conference Room, Civic Centre, Southampton, at 2.00, followed at 2.30 by the lecture already publicised on **Current and Future Legislation for the Protection of Hearing at Work.**□

Letter from the Vice-President Groups and Branches

The Annual Meeting of the Group and Branch representatives was held in October. This meeting provides a forum for the discussion of problems and the exchange of ideas between Groups and Branches and members of Council.

The major item on the agenda was the review of activities, which highlighted the fact that whilst Groups continue to flourish, and generally serve the needs of their members, many Branches are struggling to maintain the interest of their members. There was general discussion on methods of overcoming the problems and, in particular, it was suggested that:

a) Branches need not keep their programme entirely to acoustic matters. Informal visits and lectures in other subject areas might attract members and provide an informal forum for 'acoustic' discussions.

b) Non-members should be encouraged to attend meetings.

c) Good speakers may be enticed to a repeat performance in another part of the country if time intervals can be kept short. Meetings Committee could act as liaison.

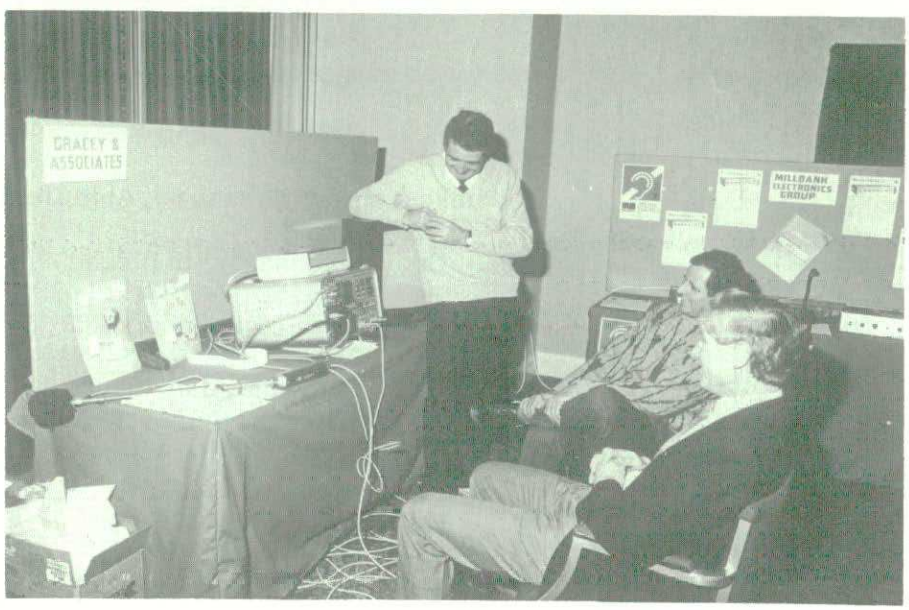
d) Groups and Branches should get their programme advertised in the Bulletin and diary as soon as possible.

To me these seem eminently sensible ideas and committee members might care to take heed. The successful branches do appear to be following these suggestions already and reports of successful meetings in the Bulletin will help spread the ideas.

Finally, I have for some time heard some members bemoaning the fact that they do not get a lot out of the Institute and since becoming Vice-President I have found Group and Branch committee members trying to find out just what it is that members want. Maybe the two could get together and discuss matters across a pint or two at a social function.□

Geoff Kerry
Vice-President, Groups and Branches

Autumn Conference 1985

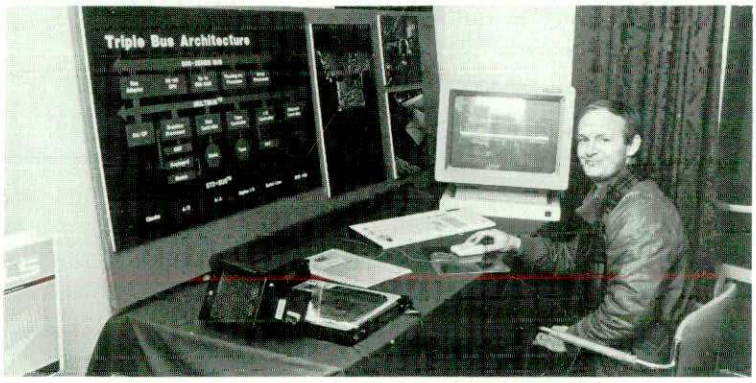


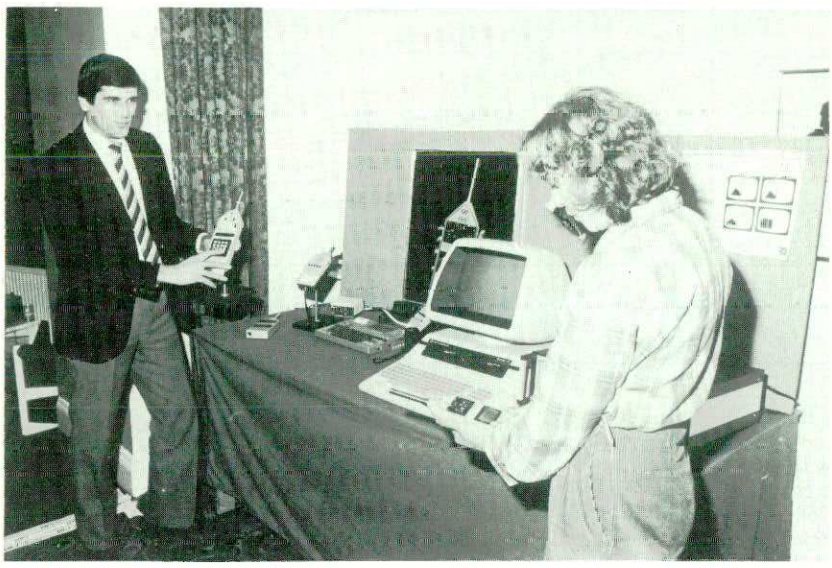
Reproduced Sound

The 1985 Autumn Conference of The Institute of Acoustics was held from 1 to 3 November at the Hydro Hotel, Windermere. This was a collaborative venture between the Institute, the Audio Engineering Society (AES), the Electroacoustic Music Association (EMAS), the Association of Sound and Communication Engineers (ASCE) and the Association of Professional Recording Studios (APRS). The aim of the Conference was to allow all concerned with the science, art and practice of reproduced sound to meet in informal surroundings to present and hear reports and demonstrations of recent developments in this field and to exchange views. The result was a gathering with rather more emphasis on the commercial aspects than is normally the case at IOA Conferences.

The Conference proved enormously successful, with a programme that was bursting at the seams and a good many delegates having to be dispersed to other Hotels in the area. There were also rather more exhibitors than usual for an Autumn Conference; a full list of exhibitors is given overleaf.

The Institute would like to record its thanks to the collaborating bodies and the exhibitors for all their efforts in making the Conference such a success.





Autumn Conference 1985: Exhibitors

The following firms participated in the technical Exhibition at the Conference, recorded photographically on pp 10 and 11 by a well-known member of Meetings Committee!

Accusound
B & W Loudspeakers
Brüel & Kjær (UK) Ltd
CEL
Cirrus Research Ltd
Gracey & Associates
HHB Hire & Sales
Hakuto International
Industrial Acoustics Ltd
Kemo Ltd
Masscomp UK Ltd
Millbank Electronics Ltd
Scientific Atlanta Ltd
Shuttlesound Ltd
Technical Projects Ltd

Our apologies to anyone who slipped through the photographer's net.□

In case you didn't hear...

Mike Ankers, our Meetings Committee Chairman, has been appointed Assistant Director of Environmental Health (Pollution/Operational) at the City of Manchester. We offer our congratulations on his promotion.□

IOA Diploma Examination 1985

The following candidates are to be congratulated on qualifying for the award of the IOA Diploma in Acoustics and Noise Control.

North East Surrey College of Technology

M J Barrett, N J Barrett, M Carnegie
J A Carter, R A Cox, L B Cronin
N Frampton, J H Hamilton, S D Hedley
G W Jones, P M Lehane, Miss M C Maharaj
Miss E A Morling, S Nejand, A J Purdue
P R Reddell, M J Slagter, M J Stubbings
C J Thomson, Mrs J E Unsted, C T P Vigar
R F Whiteman

Liverpool Polytechnic

S Avann, Mrs L C Brown, M A Carson
G Chambers, J Cottam, I C Critchley
Ms L Duckworth, K L Malbon, S Maslivec
Mrs M C Merriott, P S Ramsden, S M Sheridan
D Thomas, P Woods, C J Yates

Cornwall College of Further and Higher Education

D Gibson, D T Jones, G M Joy
R Thorne, J G Tringham

Leeds Polytechnic

M Cattley, Miss E J Fordham, P M Robson

Bristol Polytechnic

A S Anderson, M J Crocker, N R Higgs
W I Holmes

IOA Diploma Summary 1985

	General Module			Architectural Acoustics			Noise Control Engineering			Transportation Noise			Vibration Control			Law and Administration			Instrumentation and Measurement			Totals					Pass %	Projects Complete
	M	P	F	M	P	F	M	P	F	M	P	F	M	P	F	M	P	F	M	P	F	M	+ P	+ F	→	T		
A	—	24	4	3	7	1	—	22	3	—	—	—	—	—	—	1	21	2	1	6	2	5	80	12	→	97	87.6	21/39
B	6	11	2	8	4	1	—	2	—	1	12	1	—	—	—	—	9	3	2	—	—	17	38	7	→	62	88.7	20/20
C	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	→	2	100	
D	—	4	2	—	7	1	—	—	1	—	2	—	1	1	—	—	6	2	—	3	—	1	23	6	→	30	80	5/16
E	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	3	—	→	3	100	2/3
F	2	4	—	—	—	—	—	4	2	—	—	—	—	—	—	1	5	—	—	—	—	3	13	2	→	18	83.3	4/7
G	7	17	—	13	2	—	2	2	3	—	17	—	—	—	—	—	10	4	—	—	—	22	48	7	→	77	90.9	28/32
H	2	9	1	—	—	—	1	8	3	—	1	—	—	—	—	—	11	1	—	—	—	3	29	5	→	37	86.5	13/16
J	2	2	—	—	—	—	—	4	1	—	—	—	—	3	—	—	3	—	—	—	—	2	12	1	→	15	93.3	6/8
K	2	2	—	—	1	—	—	1	2	—	2	—	—	—	—	—	—	—	—	—	—	2	6	2	→	10	80	3/4
N	2	11	2	5	7	2	—	1	—	—	—	—	—	—	—	1	11	1	—	—	—	8	30	5	→	43	88.4	14/15
Totals	23	86	12	29	28	5	3	45	15	1	34	1	1	4	—	3	77	13	3	9	2	63	283	48	→	394		116/160
Module Pass %	90.1			91.9			76.2			97.2			100			86			85.7			87.8						72.5

Key to Diploma Centres:

A: North East Surrey College of Technology
B: Liverpool Polytechnic
C: Newcastle Polytechnic
D: Cornwall College of Further and Higher Education
E: Leeds Polytechnic
F: Bristol Polytechnic
G: Tottenham College of Technology
H: Derby Lonsdale College of Higher Education
J: Colchester Institute of Higher Education
K: Heriot-Watt University
N: Ulster Polytechnic

Tottenham College of Technology

S A Bowman	J Bradley	I D Chapman
G H Davies	A J Edmunds	S J Fisher
T Hetherington	D Horrocks	W J Legassick
Miss J Liebeschuetz	C D Lomax	E A Massey
K L Mehaffy	C D Nevitt	S G Pritchard
S R Reeves	F R Robotham	T P Sadler
M Saunders	Miss S J Swingler	K A Wade
R A Whitehouse	M K Winter	

Derbyshire College of Higher Education

D Appleby	W Buckley	I P Fletcher
J E Grant	A J D Jarvis	K J Lawson
I Moore	R I Osborough	L Smith
M Taylor	S Walker	

Colchester Institute

G P Curd	I S Haines	A J Hughes
Mrs F C M Moor	M A Nelson	B H Saunders

Heriot-Watt University

K Malcolm	D Martin

University of Ulster

L G Backwell	D Boland	S J Cooper
N A Crawford	K Doherty	J M Fleming
R H Gaston	M G Kelso	G McCurdy
P J Scott	R J Sergeant	J N Shields

Congratulations also go to the candidates listed below for obtaining passes in additional Specialist Modules in 1985.

L B Cronin	S P Dart	P G Gough
C D Harland	P Hunnaball	W J Legassick
Miss M C Maharaj	A J C Martin	A McWillie
D R Morris	D J Parker	M I Redman
P A Rolando	J G Tringham	

IOA Diploma Examination 1985

The year saw the first drop in entries since the Diploma commenced. A decrease in numbers has been expected for some years, since it was realized that the first few sittings of the examination would draw on an existing, but limited, pool of candidates. However, looking ahead, we expect an increase in 1986 following determined publicity initiated by Roy Lawrence, Chairman of the Education Committee.

The 1985 results are summarized in the table which shows the Merits (M), Passes (P) and Failures (F) at each College for each Module. The percentage rates are similar to previous years, maintaining the high standard which has been established for the Diploma.

The Instrumentation and Measurement module was new in 1985 and attracted candidates from only three centres. The Examining Board expects that, as the Module becomes established, it will grow in popularity, filling a genuine need in explaining the complexities of modern instrumentation.

There was some improvement over previous years in the number of Project completions: 72.5% in 1985 compared with 54.7% in 1984. The Examining Board considers 72.5% to be an unacceptably low completion rate and the Project is being carefully monitored.

Once again, Headquarters coped magnificently with the administration of the Diploma, in which the peak pressure arises in July and August. Each script is checked to ensure that it has all been marked, that the section marks have been added correctly to give the question total and that the total for the paper is correct.□

H G Leventhall

On the Move

Brüel & Kjær have moved from their Hounslow premises to a new address in Harrow. Henceforth those two-tone green boxes, along with B&K's technical literature and other services to acousticians, will be available from:

Harrow Weald Lodge
92 Uxbridge Road
Harrow
Middlesex
HA3 6BZ
Telephone: 01-954 2366.
Telex: 934150 BK UK G.
Fax 01-954 9504.

New Elections

The following elections have been approved by Council.

Fellow

E Buchta	R Parker

Member

D W Coffey	D Lindsay
D P J Coughtrie	G S McCleave
M D Croker	W L Parkinson
S Dracup	J Peck
D Fairhall	R N Wade
S A L Glegg	R J Weston
A D G Harvey	D N Williams

Associate

G J Adams	B Masukume
N J Barrett	D J Mills
I J Bollans	M A Nelson
R A Cox	R S Pickworth
J Dye	P R Reddell
K Harpur	N Reynolds
T Hetherington	T P Sadler
S D Hill	B H Saunders
M A Hines	M Saunders
W I Holmes	Y Shakur
D G Howe	D J Spode
R Irwin	W K Szeto
R W Lamont	J E Unsted
N A C Macfarlane	R F Whiteman
M C Maharaj	F Y M Wong
S Maslivec	J Zarins

Student

A J Bullmore	J Lloyd
C Howorth	

The Great Highland Bagpipe of Scotland

A review of the acoustical research

Alex R Carruthers

Introduction

Exploring the physics and acoustics of musical sounds and instruments is an attractive and active but diminutive field of research, carried out by a few individuals usually with interests in other work. Within this small domain lie sub-groups with even smaller interest areas and one such area is the collection of data on and understanding of the sounds from woodwind instruments. In many ways unique among the woodwinds stands the *Piob Mhor,* the Great Highland Bagpipe of Scotland. Although modern in manufacture, many present-day instruments still retain a sound which has changed little from ancestral times.

A pictorial representation of the modern Highland bagpipe and its player is shown in Figure 1. Its principal components are a skin bag to act as an air reservoir, a blowpipe which allows the player to keep the bag filled with air and pressurized, and a chanter for playing the melody. The chanter is by far the most important component and its sound is accompanied by three steady sub-octave notes produced by the drones.

Research publications are few and far between and direct research work seems to be almost zero. Indirectly, of course, many papers on woodwind instruments cover parallel topics of relevance to the mechanisms within the Highland bagpipe.

The general three-part concept of an acoustical system in Figure 3 involves a source (the Highland bagpipe), transmission path (the air path between the piper and listener) and a receiver (one or more listeners). However, in such musical acoustical systems, this concept is by itself insufficient since the musical instrument cannot be divorced from the player. A more realistic view of the system as it applies to the Highland bagpipe is shown in Figure 4 and involves interactive feedback paths between the bagpipe and the player. The presence of a listener may also return signals which affect the player and ultimately the sound he or she controls.

Isolating the instrument from the player may permit important understanding of its physical characteristics but combining the player with the instrument provides a more realistic characterization of the sounds that people hear (active sounds). The technical literature available on the Highland bagpipe covers both these aspects.

Work on the bagpipe first appeared in the literature in 1885 with an analysis of the scale of the chanter but it was not until 1940 that the work of Allan (1) set the scene for the scientific community with a more ordered analysis of the chanter. However, fourteen years elapsed before the next investigation in 1954 when a definitive paper by Lenihan and MacNeill (2) on the scale of the traditional chanter was published. The next contribution was in 1963 by Harris, Eisenstadt and Weiss (3) with a spectral analysis of the active (blown) sounds of the bagpipe. Another fifteen years passed and 1978 saw two papers published, one on the spectra of the active sounds (4) and another covering a number of topics including the passive resonances of the chanter (5). A few minor contributions have been published as letters (10), (11) and remarkably good general articles published in specialist piping magazines (6), (7).

Although some six or seven worthy papers have appeared on the acoustical characteristics of the Highland bagpipe, they have left a massive field of research still untouched.

Outline of the Research

Allan (1): 1940

This is perhaps the best paper to mark the entry of serious scientific study on the Highland bagpipe in the recognized scientific literature. It addressed itself to the task of quantifying the musical scale of the blown chanter. The paper has a useful introduction to pseudo-scientific work done on the pitch of the chanter by A J Ellis (1885), D J Blaikley and J MacNeill (1901).

In Allan's work, the pitch of eight chanters played by professional and amateur pipers was derived, some chanters being played by mouth and others attached to the bag in the usual way. From these measurements the intervals in the scales were derived. Allan attempted to measure the fundamental modes of vibration of the

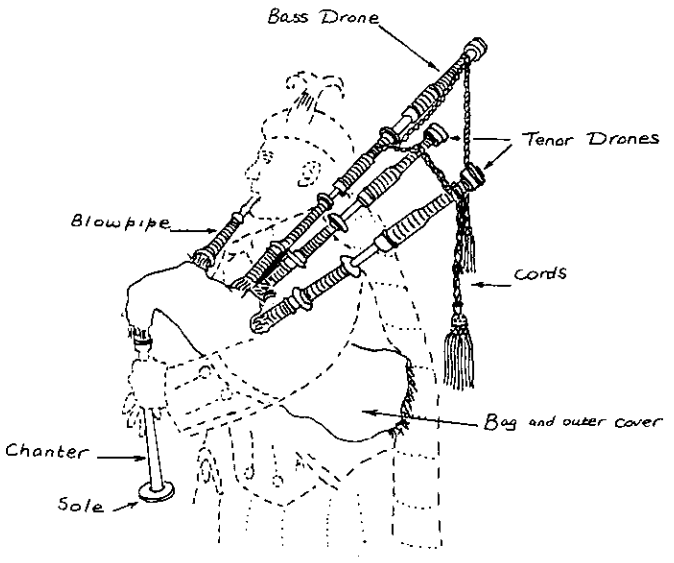


Figure 1 The Great Highland Bagpipe of Scotland

Figure 2 Dismantled Bagpipe

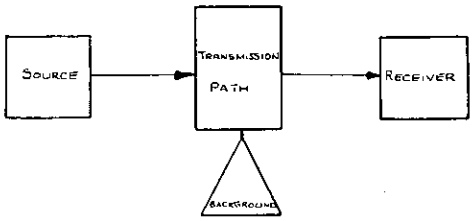


Figure 3 The general system

isolated chanter reed and quotes the frequencies.

The results of the sounds from the active chanter were assembled as a graph showing the fundamental frequency of the note as a function of the distance from reed tip to the hole representing the blown note. The graph was used by him to postulate and make a chanter with holes made at positions predicted from the graph. This home derived chanter proved too difficult to finger as some of the finger holes were irregularly spaced and too close together. He did not appreciate the full implications of woodwind finger holes and bores and it was much later, with the work of Benade (8) and Nederveen (9), that an understanding of these mechanisms began to emerge.

Lenihan and MacNeill (2): 1954

This work has become recognized as the standard text on the frequencies and intervals of the active notes of the chanter. Although time has since elapsed and some newer makes of chanters with different pitch have emerged, the paper remains the definitive document on the scale of the majority of chanters currently in use.

A number of professional pipers played the bagpipe scale in various ways and the fundamental frequency of each note determined. Eighteen chanters were used in the tests and the mean interval between successive notes and the mean fundamental frequencies determined.

MacNeill and Lenihan (6): 1960

Although not part of the general scientific literature, the series of articles of this reference forms an interesting and thorough exposition of the history and work done on the scale of the chanter.

It covers the experimental results of A J Ellis: 1885 (4), D J Blaikley, C S Thomason: 1906, G E Allan: 1940 (1) and J M A Lenihan and S MacNeill: 1954 (2). Numerous tables of fundamental frequencies of the notes of chanters, their musical intervals and the authors' comments, criticisms and discussion of this work provide valuable historical information and reference data.

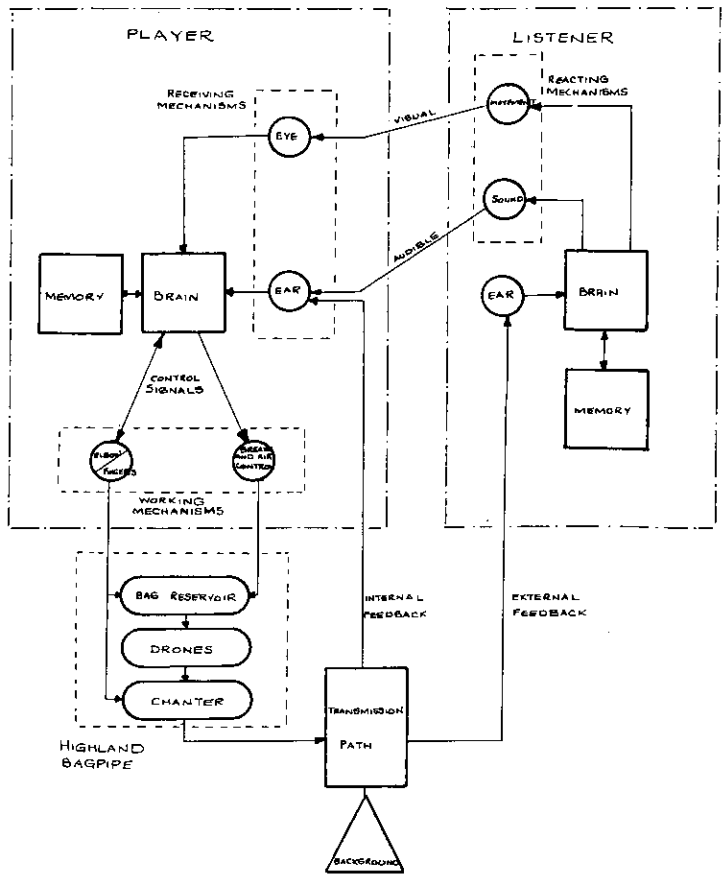


Figure 4 The interactive system

A short history of theoretical analysis on the scale is outlined. The reference concludes with a detailed description and presentation of the experiment and results eventually published by the authors in reference 2.

Harris, Eisenstadt and Weiss (3): 1963

Harris, Eisenstadt and Weiss were among the first to publish work on the acoustical spectra of the sound produced by the individual pipes of the Highland bagpipe. Their work embraces a number of factors and sets the scene for many worthy areas of research.

A number of analyses of recordings made in a sound-proof room by three professional and one amateur piper were presented.

The main theme of the paper was the presentation of harmonic measurements of the drones and chanter under normal steady state conditions. The chanter scales were found to have frequencies within 1% of those given in reference 2. The spectra illustrated both even and odd harmonics up to at least 8 kHz (the limit of the measuring equipment) with an acoustical peak at 2 kHz. The range of practical bag air pressures used was 56 cm H_2O (5.494 kPa) to 92 cm H_2O (9.023 kPa). The effect of bag pressure on the spectra as the sound builds up to a steady state was investigated and revealed that the higher frequency harmonics have high magnitude at low bag pressure but reduce as the bag pressure increases.

As well as the spectra produced by notes from standard fingering, those produced by false fingering were given. They found that incorrect fingering, as expected, led to changes of fundamental frequency but, surprisingly, the shape of the spectral envelope remained substantially unchanged.

Some results of the effects of the ageing processes in the chanter reed over a three-month period suggested that the higher frequency components of chanter notes reduced in magnitude to produce a more 'mellow' sound.

The sound pressure level (1 metre) S P L of drones was shown to be between 70 dB and 77 dB (linear) and the chanter to be between 92 dB and 82 dB (linear) depending on the note played. Variations of S P L were about 4 dB depending on bag pressure or the fingering technique used.

Finally, some time transient effects were analysed to show how the temporal and spectral characteristics altered as the sound switched over from one note to another. This changeover was found to occur in less than 24 ms and was

accompanied by an impulse in the time waveform.

MacKenzie (4): 1978

MacKenzie's presentation is in the form of a description of his findings to a non-technical audience but contains many valuable results on the relative intensity of the harmonics of chanter and drone sounds.

Use of a small anechoic chamber and the assistance of four leading professional pipers and one amateur piper provided the author with the source material.

Numerous spectra were presented which demonstrated a wide difference in the harmonic structure of the bagpipes even when of the same pitch. The experienced professional pipers were observed to have tenor drone pairs with spectra of matching envelopes. The drones of Pipe 4 were partly lined with metal and by comparison with the others, they had the widest set of harmonics of significant magnitude. MacKenzie correctly attributed this to the lower friction providing higher frequency harmonics.

The paper concludes with measurements which suggest that high bag pressure generally enhances the intensity of the low frequency harmonics and low pressure increases the intensity of higher harmonics. This is in agreement with Harris *et al* (3). The range of pressures covered was 0·04 to 0·08 atmospheres (4·05 to 8.1 kPa). The sitting piper was found to exercise a higher bag pressure than when standing.

Firth and Sillitto (5): 1978

This work is an attempt to derive information which may allow for a better understanding of how the chanter and its double reed interact to produce the sound.

Measurements were made in an anechoic chamber using a chanter made by 'Thow of Dundee'. They commenced with a study of the acoustical input impedance and resonances of the chanter excited by a volume current source (an ionophone). The results illustrated that the relationship between the harmonics and the fundamental resonance was not linear but displayed 'stretched intervals'. From these, the Q-factors of the fundamental resonances were derived and shown to decrease as the scale (and pitch) was ascended. The authors postulated that the lower onset time of the higher pitched notes (onset time being proportional to $\frac{Q}{f}$) is the contributory factor for their dominant use as grace notes in pipe music.

An interesting set of measurements was of the spectra for the blown double reed of the chanter. Three active sound regions were identified (known by the authors as 'croak', 'sub-harmonic' and 'smooth-tone' regions). The spectra for the 'smooth-tone' region were marked clearly with identifiable and separable harmonics, whereas the spectra for the other regions, although showing segments with high harmonic content, had broken and noisy envelopes.

The work concluded with an attempt to show the interaction of the vibrating reed with the resonances of the chanter. It records those frequencies with coincidences between reed harmonics and the harmonics of the composite sound.□

References

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2. *An Acoustical Study of the Highland Bagpipe.* J M A Lenihan and S MacNeill, Acustica **4**, 231-232, 1954.

3. *Sounds of the Highland Bagpipe.* C M Harris, M Eisenstadt and M R Weiss, JASA **35**, 1321-, 1963.

4. *Comparison of Bagpipes by Harmonic Measurement.* A C MacKenzie, Proc Piobaireachd Society Conference, Middleton Hall, Gorebridge, April 1978.

5. *Acoustics of the Highland Bagpipe, Chanter and Reed.* I M Firth and H G Sillitto, Acustica **40**, 310-315, 1978.

6. *The Scale of the Highland Bagpipe.* S MacNeill and J M A Lenihan, Piping Times **13**, No 2, 7 Nov 1960, published by College of Piping, Glasgow.

7. *Post Script on the Scale of Chanters.* S MacNeill, Piping Times, 3 December 1974.

8. *On the Mathematical Theory of Woodwind Finger Holes.* A H Benade, JASA **32**, No 12, 1591-1608, 1960.

9. *Acoustical Aspects of Woodwind Instruments.* C J Nederveen, Fritz Knuf, Amsterdam, 1969.

10. *Pitch Changes in the Sound of the Highland Bagpipe.* A R Carruthers, Acustica **41**, No 1, 46-50, 1978.

11. *Sound Radiation Characteristics of the Highland Bagpipe in open air.* A R Carruthers, Acustica **38**, No 2, 153-156, 1977.

The Prince of Wales Award

for Industrial Innovation and Production 1986-1987

THE PRINCE OF WALES AWARD
For Industrial Innovation and Production

THE Prince of Wales Award for Industrial Innovation and Production was first inspired by His Royal Highness the Prince of Wales in 1980; it aims to encourage the creation and growth of new business based on British inventions and new technology. The Award is organised by The Engineering Council.

Entries are invited from a wide range of people and organisations including private individuals, small firms and new businesses, other companies of all sizes, academic researchers and universities, polytechnics and other research institutions. The subject of the entry must be a new product or process which incorporates a British invention or a significant technical innovation and leads to the creation of new business or the marketing of a new product.

A minimum of six finalists will be selected, to receive a Prince of Wales Award certificate, and the overall winner will receive a certificate, a trophy and £10,000. The Chairman of the judges will be Sir Monty Finniston FEng, FRS.

A small number of entry forms are available from IOA HQ in Edinburgh (photocopied entry forms will *not* be accepted) and all entries must be received by the closing date of **31st January 1986.**□

All Change

Those of you who pay attention to such details — and we know that some of you do — will notice that from this Bulletin we have stopped changing -ze to -se and are now busily changing -se to -ze. This brings us into line with such eminent bodies as the British Standards Institution and the Oxford University Press; many will say, not before time!

A few words of course will still be spelt with s, for etymological reasons, notably advertise and analyse (except when misspelt in a trade name!) Your Editor has worked for so long with -se that a few may slip through; no prises for spotting them!□

Fifth FASE Symposium

The Fifth Symposium of the Federation of Acoustical Societies of Europe. Greece, 26 — 29 August 1985

Dr Tzekakis, president of the Hellenic Acoustical Society, and his colleagues organised a first class symposium in Thessaloniki on a theme entitled **The Integrated Design of the Acoustic Environment.**

The framework for the meeting was provided by six invited lectures with parallel sessions of contributed papers arranged in between. The titles of the invited lectures together with the names of the authors give a good impression of the scope of the presentations and are listed below with additional comments where appropriate.

Prof M Heckl. Berlin, FRG.
Some structure borne noise problems in buildings.

Prof H Kuttruff. Aachen, FRG.
Sound Propagation in working environments.
A new prediction theory was proposed which agrees well with experimental results.

Dr J Lang. Vienna, Austria.
Sound insulation in buildings; requirements and basic data for design.

Prof A Lauber. Duebendorf, Switzerland.
Room acoustics in architectural design.

Prof H Myncke. Leuven, Belgium.
Applications of sound intensity measuring techniques in building and room acoustics.
Measurements of Sound Transmission Loss were carried out using both sound intensity and traditional methods and the results were in good agreement at all except the lowest frequencies.

Dr R J Orlowski. Salford, UK.
Recent work on acoustic scale modelling — A tribute to Professor Peter Parkin.

Other papers of particular interest were by Prof J Blauert on auditory spaciousness in concert halls; by Dr Jurgen Meyer on balance problems in opera houses and two papers by Dr P Brüel — no wonder that his company is so successful.

It is evident from the above list that the symposium was not lacking in professors; over 10% of the delegates were of professorial status or its equivalent. This provided two welcome features during the meeting: first it resulted in frequent perceptive questions and valuable comments during discussion periods and secondly it provided young researchers with the opportunity to discuss their ideas with leaders in the field.

During the symposium the FASE Council held its 14th meeting to which I had the privilege of being invited as a representative of the Institute of Acoustics. An important topic of discussion was the meetings programme and readers may be interested to take note of the current plans.

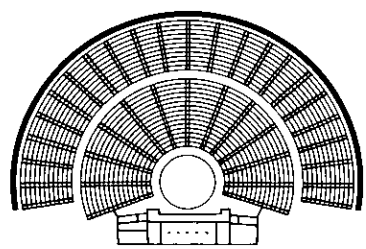
2 - 6 Sept 1986. 6th FASE Symposium, Sopron, Hungary.
Theme: **Subjective Evaluation of Objective Acoustical Phenomena**

22 - 24 June 1987. 5th FASE Congress, Lisbon, Portugal.
Themes: **Advances in the domain of Physical Acoustics,** in particular
Oceanographic Acoustics
Use of acoustics in Bio-engineering
Optoacoustics
Harmonisation of legislation on the protection of hearing.

19 June 1987. Specialised Symposium, Madrid, Spain.
Theme: **Acoustics and the ocean bottom**

1988. 7th FASE Symposium, Edinburgh, UK (to coincide with the Festival).
Proposed Theme: **Speech**
This FASE Symposium will be hosted by the IOA.

Throughout the symposium the hospitality of the Greeks was magnanimous, from the first bottle of ouzo supplied with the conference papers to the splendour of the closing dinner. The organization was well thought out and the atmosphere and pace were always relaxed, any requests from the delegates were always greeted with the reassuring phrase 'no problem'. I look forward to more meetings hosted by the Hellenic Acoustical Society whose antecedents in antiquity are still respected and are emphasized by their enviable emblem.□



R J Orlowski

AES Publishes Standards

The Committee on audio engineering standards administered by the Audio Engineering Society has now been accredited by the American National Standards Institute (ANSI) for the development and publication of standards and information documents in the audio engineering field.

The AES has published five ANSI-approved standards concerning loudspeaker components for sound reinforcement, magnetic tape, and digital audio engineering. The following are the specific numbers and titles of the standards and information documents.

AES2-1984 (ANSI S4.26-1984) AES Recommended Practice. Specification of Loudspeaker Components Used in Professional Audio and Sound Reinforcement.

AES3-1985 (ANSI S4.40-1985) AES Recommended Practice for Digital Audio Engineering — Serial Transmission Format for Linearly Represented Digital Audio Data

AES5-1984 (ANSI S4.28-1984) AES Recommended Practice for Professional Digital Audio Applications Employing Pulse-Code Modulation — Preferred Sampling Frequencies

AES6-1982 (ANSI S4.3-1982) Method for Measurement of Weighted Peak Flutter of Sound Recording and Reproducing Equipment

AES7-1982 (ANSI S4.6-1982) Method of Measuring Recorded Flux of Magnetic Sound Records at Medium Wave-lengths

For further information and orders in the UK, please contact: AES British Section, Lent Rise Road, Burnham, Slough, SL1 1NY, UK.□

New Products

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

Simplified Vibration Monitoring

Two new products recently introduced by CEL Instruments are designed to be incorporated into multichannel permanent machine condition monitoring systems. The CEL-191 Accelerometer is a low-cost, rugged piezo-electric transducer designed to be used with the CEL-217 Charge Amplifier. Signal conditioning within the CEL-217 provides a standard output signal that can be connected to alarm devices, recorders or frequency analysers. Easy system calibration is obtained since the charge amplifier has a built-in calibration signal and a variable transducer sensitivity control enables it to be used with a wide range of accelerometers other than the CEL-191. Both acceleration and velocity outputs can be obtained.

Quality Control System for Noise and Vibration

Simple production line checking of product noise and vibration levels can be made using the CF-310 Spectrum Comparator. The CF-310 uses FFT analysis. Input signals from a wide range of transducers can be analysed and the resulting spectrum compared with set limits to produce a clear-cut go/no-go output. An easily understood interactive CRT dialogue allows up to 15 limit levels to be established for a frequency spectrum. When a no-go situation is established control lines are available through the CF 010 Relay Box to alert alarm systems or automatically switch off equipment.

Further details on the above products from Lucas CEL Instruments Limited, 35 Bury Mead Road, Hitchin, Herts SG5 1RT. Tel: 0462 52731.

Sound Level Meter GA204

The latest addition to the Castle Associates range of Sound Level Meters, the GA204, is a type 2 instrument designed for both Industrial and Environmental noise work. The GA204 is capable of measuring background levels down to 20 dB(A). It also has a 'press to hold' button which displays the highest level of a noise event on the meter until the button is released.

New Hire Service

Castle Associates have launched a Hire Division offering a wide range of their noise and vibration measuring equipment for short term rental. Further details from Castle Associates Ltd, Salter Road, Scarborough YO11 3UZ, Tel: 0723 584250.

Silent Page

Designed especially for the hearing impaired, the Silent Page is a fully portable, battery operated noise warning system. The system has 2 components — a transmitter and a wrist-worn receiver. When the transmitter 'hears' a specified sound such as the cry of a baby, a fire alarm, burglar alarm or doorbell etc, it transmits a coded radio signal to the wrist-worn receiver. The receiver then vibrates strongly to inform the wearer that the noise is occurring. A series of lights on the receiver shows the source of the sound. The receiver is supplied, as standard, with two transmitters but up to 15 transmitters can be used with each wrist receiver.

Noise Dosemeter Micro-15

The Micro-15 measures a series of Short Leq values (62.5 millisecond in duration) and combines these using its internal computer to give all the common noise parameters including Leq, Dose, Sound Exposure Level (SEL), Peak and Sound Level. In addition the Micro-15 has readouts of total measurement time, pause time, and total overload time. A printer can be connected to the RS232C output enabling all 15 functions and 7 parameters to be printed out at 600 baud. A further 'DATA' output allows the Micro-15 to be connected to a microcomputer on line to allow up to 120,000 short Leq samples to be acquired. With Cirrus software this allows the total noise climate to be computed over a two-hour period and all of the statistical levels, eg L10 and L90, to be computed.

The Micro-15 and the Silent Page are produced by Quest Electronics and are distributed by Cirrus Research Ltd, 1-2 York Place, Scarborough, North Yorkshire, YO11 2NP. Tel: 0723 371441.

BASEEFA Approval for A/72/F Accelerometer

The A/72/F accelerometer made by D J Birchall Ltd has received the BASEEFA Intrinsic Safety Approval. This accelerometer incorporates the 'Konic' shear element giving it low base strain and transverse axis sensitivities. The integral charge to current converter is on a Hybrid substrate, also manufactured by D J Birchall. The ac current signal is carried on the same wires as the dc power supply. Output from the device is 100 μA/g rendering monitoring of low 'g' signals possible. As the body of the accelerometer is all welded and the two pins of the connector are fitted via glass-ceramic seals, the accelerometer is hermetically sealed.

Further details from D J Birchall Ltd, 102 Bath Road, Cheltenham, Glos GL53 7JX. Tel: 0242 518588.□

ISVR Short Courses 1986

7 - 9 January	Occupational Deafness
24 - 26 March	Laser Technology
7 - 11 April	Clinical Audiology
7 - 11 April	Course for Environmental Health Officers
14 - 18 April	Engine Noise and Vibration
14 - 18 April	Instrumentation and Measurement Techniques for Noise Control
June	Instrumentation and Measurement Techniques for Vibration Control
15 - 16 July	Adaptive Signal Processing — with applications to underwater systems
September	Industrial Audiology and Hearing Conservation
	Advanced Noise and Vibration
	Technical Audiology
	Applied Digital Signal Processing

For further details, contact Dr J G Walker or Mrs M Strickland at ISVR, The University, Southampton SO9 5NH. Tel: 0703 559122, Ext 2310 or 752.□

Book Reviews

Computer Speech Processing
F Fallside and W A Woods (Eds)
Prentice-Hall International (UK) Ltd.
xxi + 506 pp. £39.95. 1985.

The nineteen chapters in this volume are based on lectures given at an advanced course on 'Computer Speech Processing' at Cambridge (England) in the Summer of 1983. The contributors are acknowledged teachers as well as experts on some aspect of computer speech processing. The idea behind the course/book is for selected contributors to give a broad grounding on certain major themes (phonetics, speech analysis and synthesis, speech recognition, linguistics and language processing and speech synthesis by rule). Also included (arranged, again, around these same themes) are chapters based on one-hour lectures on 'specialized aspects or on single research results'. My comments are concerned with what type of reader should be advised to purchase this book.

A novice would find that the complexity of the introductory chapters varies considerably: an elementary introduction to phonetics does not require the same input from a reader as an elementary introduction to linear predictive coding of speech. The second doubt that I have is about the relationship between the introductory and specialized chapters. The main issue of concern is whether the introductory chapters can give enough of the background so that such a reader can understand the specialized chapters. These comments are not meant to imply that the introductory chapters are not good, only that a reader who had no background would not get enough to be able to appreciate some of the subtle arguments on the specialized topics. Another problem would be in assessing how representative the selection of themes is. Where have the authors been over-selective, where have they shown a judicious choice and been sensitive to the emphases seen by the research communnity at large?

On the other hand, a reader already working on some aspect of speech recognition who wishes to broaden his or her knowledge in some other field would find this book valuable. The success of this book will be because all of the authors have attempted to write assuming little knowledge on the part of their readers which permits communication across the disciplines involved in computer processing of speech.□

Peter Howell

Group Travel to 12th ICA

Enquiries are being made by IOA Headquarters with a view to obtaining favourable group travel arrangements for members wishing to attend the 12th International Congress on Acoustics in Toronto in July 1986. By the time this Bulletin reaches you details should be available on request from HQ in Edinburgh.□

Institute of Acoustics Meetings

1986			
15 January	SB	Code of Practice on Sound Levels in Discotheques	Lyndhurst
19 February	M	Improving Sound Insulation in Existing Buildings	London
19 February	SB	Current and Future Legislation for the Protection of Hearing at Work	Southampton
27 February	PAG	Ultrasonic Scattering and Attenuation in Solids	London
19 March	SB	Gearbox Condition Monitoring	Southampton
24 - 26 March	M	Speech Input/Output; Techniques and Applications. Joint with IEE, RSM, BSA, RSDR	London
25 March	M	Recent Advances in Active Control of Noise and Vibration	Southampton
April	SB(P)	Visit to Industrial Acoustics Company test facilities	Brooklands, Surrey
7 - 8 April	M	Ultrasound in Medicine (joint with The Institute of Physical Sciences in Medicine)	Bath
7 - 10 April	**M**	**Spring Conference: Acoustics 86.** Sessions on: Industrial Noise; Environmental Noise; High Resolution Sonar and Underwater Acoustic imaging; Acoustic Imaging and Inversion Techniques; Sound Insulation and Room Acoustics; Open Session	Salford
21 May	SB	Visit to Gatwick Airport	Gatwick
June	M	Noise and Vibration in the Aircraft and Spacecraft Industry (organised by ING)	
17 July	PAG	Acoustics and Ultrasonics as Probes of Emulsions and Dispersions	
September	M	Legal Aspects of Entertainment Noise	Liverpool

Key:

M = Meetings Committee Programme
BAG = Building Acoustics Group
ING = Industrial Noise Group
MAG = Musical Acoustics Group
PAG = Physical Acoustics Group
SG = Speech Group
UAG = Underwater Acoustics Group
LEM = London Evening Meeting

EMB = East Midlands Branch
NEB = North East Branch
NWB = North West Branch
SB = Southern Branch
ScB = Scottish Branch
SWB = South West Branch
YHB = Yorkshire and Humberside Branch

Further details from:
Institute of Acoustics
25 Chambers Street
Edinburgh EH1 1HU
Tel: 031-225 2143

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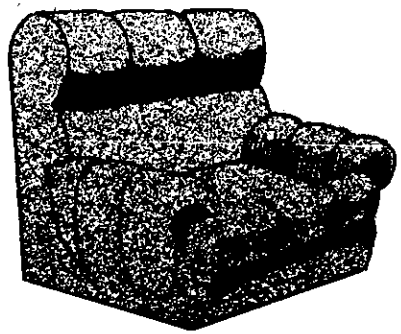

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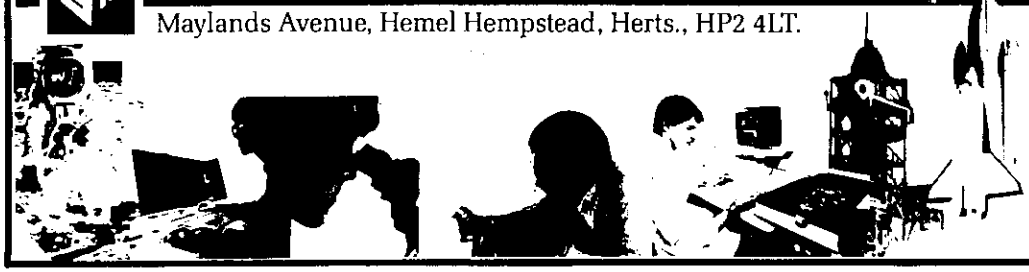

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