

Acoustics

BULLETIN

VOL 27 No3 May/June 2002



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**Spring conference Salford
Pioneers of acoustics: Lord Rayleigh
IoA Annual Report**



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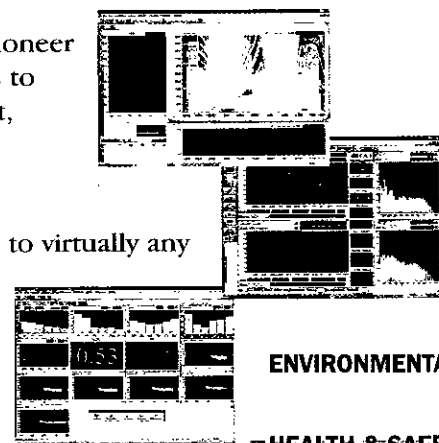
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Acoustics

BULLETIN

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Institute of
Acoustics

The Institute of Acoustics was formed in 1974 through the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society and is the premier organisation in the United Kingdom concerned with acoustics. The present membership is in excess of two thousand and since 1977 it has been a fully professional Institute. The Institute has representation in many major research, educational, planning and industrial establishments covering all aspects of acoustics including aerodynamic noise, environmental, industrial and architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics and vibration. The Institute is a Registered Charity no 267026.



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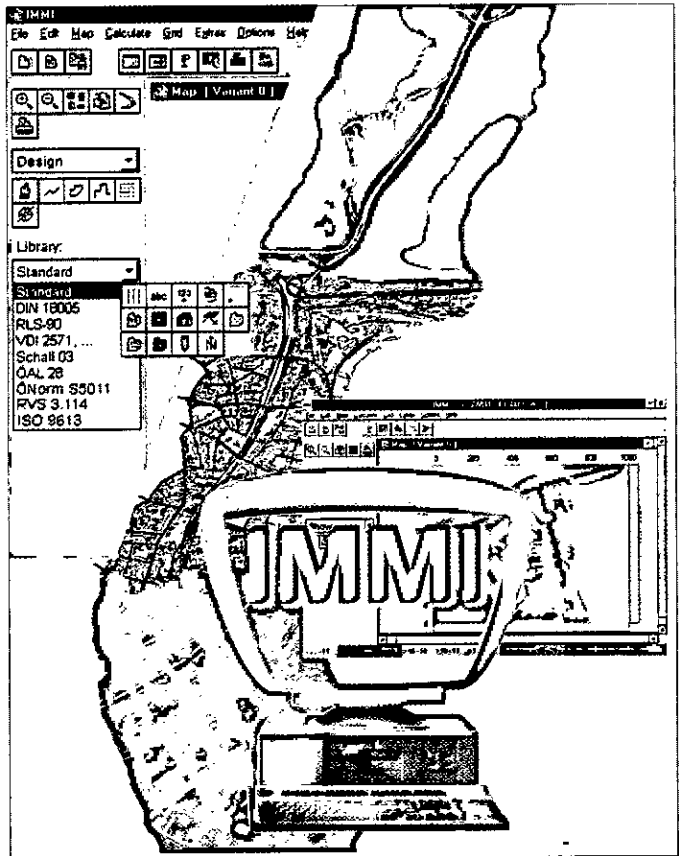
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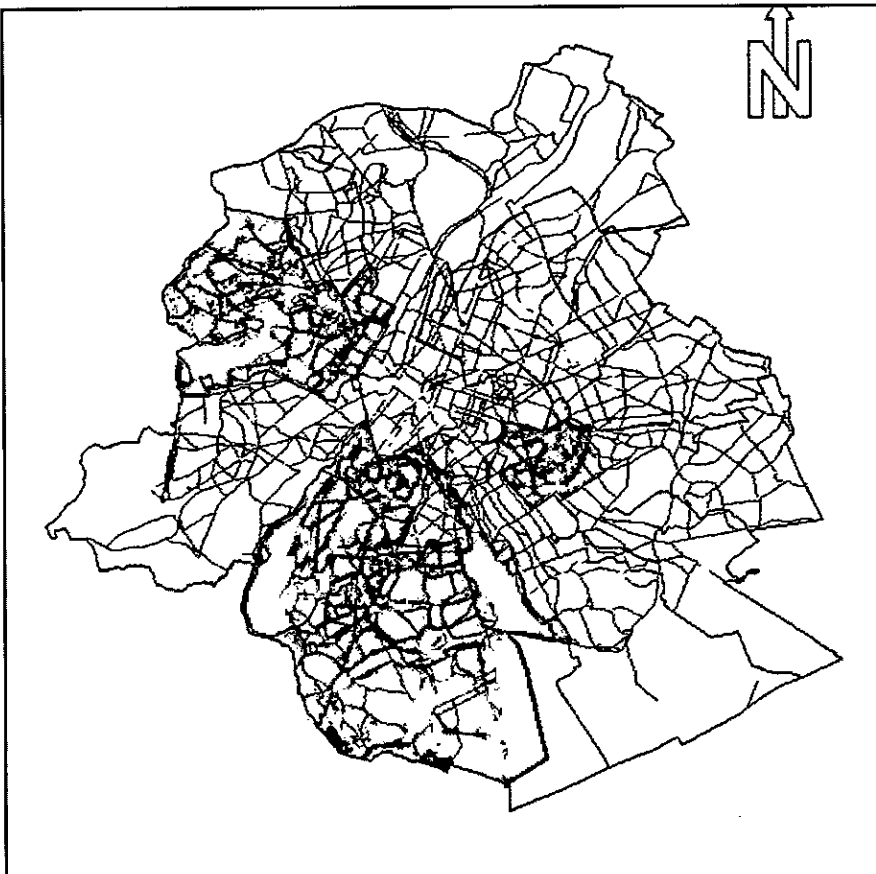
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**Dear Members**

The sun shone on Salford for this year's Spring Conference. We had more delegates than anticipated, a high standard of presentations, an excellent EPSRC Theme Day, first rate invited lectures and a visit to what is becoming one of the country's prime provincial arts centres, The Lowry.

As President, one of my more pleasurable tasks is to present the Institute's medals and awards. This year I presented the Rayleigh Medal to Professor Hideki Tachibana, the first Japanese citizen to receive it. Professor Tachibana's excellent lecture was accompanied by superb audio-graphics. He also took the opportunity to announce the introduction of the Acoustical Society of Japan's English text journal, which will give foreign readers ready access to the acoustics research in Japan.

At the conference dinner I presented an Honorary Fellowship to Alex Burd, a past president. That this took place at the Lowry was most appropriate, since Alex was involved in its design. Another important event was the presentation of the Institute's latest award, for significant individual 'Services to the Institute'. The first recipient was David Bull who has just retired as Vice-President: Groups and Branches. His award was primarily to acknowledge his contributions to the Institute's education programme.

My predecessor, Mark Tatham, has over the past two years instigated and overseen the introduction of several initiatives which will assist with the development of the Institute for years to come. I was glad to be able to pass on to him the Institute's gratitude at the Conference Dinner.

I feel I cannot end this, my first letter, without acknowledging the tremendous debt that we owe Keith Rose, our advertising manager, who sadly died recently. Keith put everything into helping the Institute and the acoustics profession is definitely the better for it.

Geoff

IOA Council: Annual Report 2001

SUMMARY

The Institute has continued to serve the interests of its members through its established programmes in the areas of education, professional development, meetings and publications, and by providing representation in areas such as the Engineering Council and International affairs.

During the year

- A Research Co-ordination Committee was formed to be responsible for improving the national status of acoustics as an academic discipline and research area and to encourage interaction between the Institute and the Research Councils
- A part-time Education Manager was appointed to improve and develop the education programme
- New arrangements for the production of Acoustics Bulletin were put in place
- A Library Working Group was formed to review the services provided by the Library and its future development
- The first examinations in the new Certificate in the Management of Occupational Hand Arm Vibration were held
- An ambitious programme of technical meetings and conferences was undertaken both at Branch level and nationally
- The Institute continued to provide the secretariat for the European Acoustics Association until August, at which time the duties were transferred to the Spanish Acoustical Society
- A new Award was introduced to acknowledge outstanding contributions to the life of the Institute

STANDING COMMITTEES

The operation of the Institute is guided by Council through Standing Committees concerned with Education; Medals and Awards; Meetings; Membership; Professional Development; Publications; and Research Co-ordination. There is also a Committee of the Engineering Division.

Education Committee

This year saw the appointment of a part-time salaried Education Manager resulting in progress being made on several important fronts, in particular the establishment of the first stage of a formal quality assurance system for all our education programmes.

The Diploma in Acoustics and Noise Control continues to be the flagship programme and it has enjoyed another successful year. Three of the existing Centres for the Diploma were successfully re-accredited (Leeds Metropolitan University, Colchester Institute and the College of North East London). For the first time the June Diploma examinations adopted a fixed pass mark which led to a higher number of appeals.

A new syllabus for the General Principles of Acoustics module was agreed and implemented in September 2001 with new syllabuses for the specialist modules planned for September 2002. Revised distance learning notes for the Law and Administration module have been prepared, to be issued early in 2002. These notes, published by the Institute, will be available for purchase by any interested parties.

New examiners for the specialist modules in Transportation Noise (Roger Tompsett) and Sound Reproduction (Bill Davies)

have been appointed. Bearing in mind the planned revision of the Building Regulations a possible higher level course is being considered by the Education Committee and the Association of Noise Consultants (ANC). This would be in addition to the certificate course in the Measurement of Sound Transmission within Buildings. Much valuable groundwork carried out during the year by the Education Committee's many hard working members should result in further achievements in 2002.

Compared with the previous year, in 2001 there was a slight drop in the number of candidates sitting the examination for the Certificate of Competence in Environmental Noise Measurement. The pass rate among the 121 papers from nine Centres was more than 90%. There was, as always, much healthy debate within the Steering Committee about the scope of the syllabus and the upholding of standards, and comments from Institute members on either matter would be welcomed by the Chairman.

Negotiations with the Environment Agency have made progress and it is expected that the Agency will endorse both the Institute's Diploma and the Certificate of Competence in Environmental Noise Measurement within their MCERTS (Monitoring Certification) Scheme. Whilst the prestige of national accreditation would doubtless enhance the attractiveness of the course to candidates and to Centres, the Committee awaits clarification of the additional administrative burden that could be imposed.

Aims for the coming year include publication of a course handbook, the recruitment of two additional Steering Committee members and the closer involvement of Centres with the syllabus review.

This was the first year that the Certificate of Competence in Workplace Noise Assessment examination dates were reduced to two per year instead of three. The change had little overall effect on the numbers, which remained fairly stable at 120 compared with 115 in 2000, but had the beneficial effect of reducing costs. The number of Centres running the course has declined and it appears that some Centres are having difficulty in justifying the expense of running courses for a small number of candidates. We are improving communication between the Centres and the Institute office to ensure that candidates can be advised of alternative venues if a Centre decides not to run the course.

During the year a draft of a new Course Handbook was produced which is intended to inform potential candidates about the content of the course. This new publication will replace the general information leaflet which has been used for both information and promoting the course. It is intended to produce a new promotional leaflet which could be used to reach a wider potential market and advertise the course and the Centres.

The successful seminars, which were run towards the end of 2000, were not repeated this year but there are definite plans to run new workshops in 2002. The main theme will be to inform existing and new candidates of the changes likely to take place with the introduction of the Physical Agents (Noise) Directive. Ian Acton, a long-standing member of the Committee, resigned during the year and we wish him well in his 'retirement' from a long career in acoustics. There are currently two vacancies on the Committee and the Chairman would welcome offers of help from those members with relevant experience. It would also be helpful to have more tutors who are currently involved with running the course serving on the Committee.

A new Certificate in the Management of Occupational Exposure to Hand-Arm Vibration ran twice during the year, and was presented on each occasion by three Centres. Dr G Paddan of the Institute of Naval Medicine has agreed to be Chief Examiner for the course. A total of 30 candidates were awarded

the Certificate. The subject is developing fast, with the recent publication of the new international standard ISO 5349, and a European Directive expected in the first half of 2002.

This should increase demand for the course, and the Committee spent some time in December discussing how best to market the course so as to increase numbers taking the Certificate, and hence maximise income to the Institute. In due course, it is hoped that more organisations will become accredited Centres for delivery of this Certificate. The Committee anticipates running a series of one day refresher courses, along similar lines to those organised by the Workplace Noise Assessment Certificate Advisory Committee, once the new European Directive has been established.

Engineering Division Committee

This year has seen a number of changes for the Engineering Division. Paul Cariss has joined the Committee as a second IMechE member and has taken part in the Professional Review interviews held during the year. Our proposal to IMechE to set up a 'bilateral agreement' to replace the long-standing 'affiliation agreement' was accepted by IMechE. The terms of the agreement were developed and it was implemented in November.

The essential difference is that, whereas in the past, all our CEng Professional Review interview results were sent to IMechE for approval and registration with the Engineering Council, the Institute now completes each candidate's registration directly with the Engineering Council, sending IMechE copy information. Thus the full responsibility for the process lies with the Institute (as is already the case for IEng), with IMechE able to monitor our work. This is a very valuable step towards independent responsibility for CEng.

Following publication of the Hawley Report, DTI supported the establishment of a more broadly-owned successor to the Engineering Council, named the Engineering and Technology Board, which was formally established in late 2001. It has membership from government, industry and academia as well as the engineering institutions. Ian Campbell and Keith Attenborough served as IOA-nominated corresponding members of the working Groups on 'industry needs' and 'education and training' during the development phase. The regulatory function of the Engineering Council has been taken over by a successor body, the Engineering Council (UK). The Institute has played a full part in the discussions leading to the inauguration of the new regulatory body and it is expected that we will continue to play an active part in its work.

Three new members, Nick Boulter, Stephen Chiles and Bernadette McKell have joined the Committee during the year. The Institute has an obligation under SARTOR 3 to monitor members' CPD. The CPD survey sheet sent to all members early in 2001 produced some valuable data for CEng/IEng members (there are more than 450 members registered with the Engineering Council). The Institute is one of a very few Engineering Council Nominated Bodies to have carried out a 100% survey, which formed the basis of an article written by Peter Wheeler for the Bulletin.

The 'chaser' letters to Stage 1 younger members have generated a good flow of enquiries and the current list of prospective CEng/IEng candidates contains some 60 names. While the demand from members working in noise and vibration consultancy remains strong, there has been a considerable increase in enquiries from the underwater acoustics sector. Six members of the Institute were registered as Chartered Engineers in 2001 and a further seventeen candidates were registered at the Interim (Academic) stage. Issue 2 of our Policy and Procedures Manual was released in March 2001. Two internal audits of the Engineering Division were carried out in 2001 and no non-compliances were identified in either audit.

Medals and Awards Committee

During the year Honorary Fellowships have been conferred on Professor Philip Doak and Alex Burd. The 2000 Rayleigh Medal

was presented to Professor Victor Krylov for his pioneering work in the field of Rayleigh waves and their application in science and engineering. The presentation took place at the Noise in London meeting held at the Commonwealth Conference Centre in London in May 2001. Professor Krylov's medal lecture was entitled Ground vibrations from rail and road traffic. The 2001 Rayleigh Medal was awarded to Prof Hideki Tachibana and will be presented at the Spring Conference and Theme Day to be held at Salford University in March 2002. The R W B Stephens Medal for 2001 was awarded to Dr Geoff Leventhall and will be presented at a meeting to be held in the autumn of 2002. The 2000 A B Wood Medal was presented to Dr Gary Heald for his outstanding research work in underwater acoustics. The medal was presented in April at the meeting on Acoustical Oceanography held at Southampton, where his lecture subject was High frequency seabed scattering and sediment discrimination. The 2001 A B Wood Medal was awarded to Dr John Colosi and presented at the Second Symposium on Underwater Bio-Sonar and Bioacoustic Systems Conference held at Loughborough University in July. His lecture was entitled: A scintillating problem: basin scale acoustic propagation through a fluctuating ocean. Other awards made during the year include the Institute's prize for the best Diploma Student which was presented to Julie May at the Autumn Conference. The Association of Noise Consultants prize for the best diploma project was won by Adrian Morgan and the Association of Noise Consultants prize for the best paper at an Institute meeting by Nigel Milton. It was planned to present these awards at the Spring Conference and Theme Day to be held at Salford University in March 2002. The joint Institute/ISVR Douglas W Robinson Prize was awarded to Sue Blandy. A new Institute award has been introduced to reward outstanding contributions to the life of the Institute. Recipients for 2001 are Dawn Connor and David Bull.

Meetings Committee

The year 2001 saw a consolidation of the new strategic role of the Committee. Nonetheless, through the hard work of many members of the Institute, a good range of conferences, meetings and workshops was held.

Stratford-upon-Avon was the venue for three conferences this year, WISP (Workshop in Speech Processing) 2001 in the Spring, the Autumn Conference, organised jointly by the Environmental and Measurement & Instrumentation Groups, and Reproduced Sound 17. Other meetings were held at venues from Strathclyde to Southampton and, amongst other things, examined current issues including the proposed revision of the Building Regulations and the possible review of BS 4142.

At a more local level, there was another vibrant programme of evening meetings arranged by the various Regional Branches covering a wide range of topics. The Committee also completed the development of a meetings strategy which was approved by Council in December 2001 and will be presented to the Groups and Branches at a meeting early in 2002.

Membership Committee

There were the usual four meetings during the year, and a total of 251 individual applications (all grades) were considered, including potential new members and transfers between grades; 186 (83 corporate, 103 non-corporate) were approved, including 13 reinstatements, and three new sponsor members were welcomed. Seventy-one individual members resigned, two died, and a further 33 names were removed for non-payment of fees. There was a net increase in individual membership of 34, compared with a loss of 11 in the previous year. The detailed figures are shown in the tables. The difficulties which arose over the approval by the Hong Kong Institute of Acoustics of applications from Hong Kong have been resolved.

continued on page 6

IOA Council: Annual Report 2001

continued from page 5

The revision of the membership documentation was completed and the new versions approved by Council. The new Code of Conduct was published in the Bulletin. Consideration is being

which provides information on the Scheme, and this has been distributed at conferences and meetings. A PowerPoint presentation has also been prepared. Details of the Scheme, assistance with career planning, and forms for recording plans and achievements have been made available on the Institute's website, and these can be downloaded directly.

Several articles have been prepared and published in the Bulletin. A survey form was sent out early in 2001 and this brought some very interesting responses. About 500 forms were returned, and we have been able to use some of the points raised to change aspects of the Scheme or its delivery. The information on the replies has been entered into a database.

The Institute continues to be represented at the Engineering Council Professional Development Forum by Peter Wheeler, who presents our ideas and also brings back information on other schemes. It is useful to know what the other Institutions are doing and we also follow where they lead in some instances. Plans for 2002 will concentrate on employers rather than members.

Publications Committee

During 2001, the Committee welcomed Matthew Ling and Trevor Cox to its numbers. Trevor has been very active on the Bulletin Editorial Board and both are making an important contribution to the virtual side of Institute Publications, together with Mark Tatham. Proceedings for the Autumn Conference and Reproduced Sound were, for the first time, issued on CD. Job advertisements are being posted on the Institute's website, which raises additional advertising revenue. Further developments in the direction of electronic publications will be seen in 2002.

Six editions of Acoustics Bulletin have been published under the new arrangements negotiated in 2000. Our Editor, Ian Bennett, our Advertising Manager, Keith Rose and our Publications Contractor, International Labmate, represented by Russell Purvis, Ann Satchell and Norman Simpson, have quickly developed an effective working relationship. The same team has been appointed to produce the Bulletin in 2002. The Register of Members was published in October.

Advertising revenue continues to increase, year on year, thanks to the hard work of our Advertising Manager. This limits the subsidy of producing the re-vamped Bulletin and Register to less than £10 per member per year. Following success of the two previous editions of the Buyers' Guide for Acoustic Products, Services and Instrumentation, which were published in 1999 and 2000, it was decided to publish a third edition in June/July 2002 and to develop plans for the production of a searchable website version.

The Library Working Group, comprising John Miller, Mark Tatham, Bridget Shield, Christine Cheepen and Roy Bratby, was reconvened in April 2001. Its report on the future of the Institute Library is currently in preparation.

Research Co-ordination Committee

The Committee held its inaugural meeting in February 2001. Since its formation the Committee has augmented its membership to include representatives from all aspects of acoustics research and some representation from the research user community. The Committee has been involved with a survey of Institute members' research activities (through the Bulletin) and has worked with the EPSRC.

Interaction with EPSRC has concerned the EPSRC list of Research Topics (which does not include acoustics explicitly at present) and the organisation of an Acoustics Theme Day as part of the 2002 Institute Spring Conference. The Research Survey returns have identified 67 acoustics-related EPSRC grants since 1997 and 42 grants funded from other sources. Significant numbers of returns have been from non-Institute

TABLE 1: MEMBERSHIP

Grade	2000	2001
Hon Fellow	16	16
Fellow	222	209
Member	1294	1315
Associate Member	676	686
Associate	111	117
Student	45	55
Totals	2364	2398
Key Sponsor	3	3
Sponsor	24	26
Institutional Subscriber	14	15

TABLE 2: GROUP MEMBERSHIP

Group	2000	2001
Building Acoustics	460	440
Electroacoustics	101	100
Environmental Noise	613	591
Industrial Noise	386	362
Measurement & Instrumentation	93	89
Musical Acoustics	85	82
Physical Acoustics	64	62
Speech	79	69
Underwater Acoustics	124	119

TABLE 3: BRANCH MEMBERSHIP

Branch	2000	2001
Eastern	247	247
Irish	93	104
London	562	569
Midlands	345	360
North West	261	262
Scottish	125	125
South West	201	209
Southern	433	457
Yorks/Humberside	178	185

given to a new grade of membership at the technician level, following the ideas put forward by the Engineering Institutions, and the opportunity will be taken to remove the confusion between 'Associate Member' and 'Associate' by renaming the latter. John Bowsher resigned from the Committee, having given many years of faithful service, and Jo Webb and Paul Freeborn have joined.

Professional Development Committee

The Professional Development Committee has continued to explain and promote the new Scheme, now goal based rather than counting hours. A 'flyer' has been produced

TABLE 4: DETAILS OF EMPLOYMENT

Employment category	2000	2001
Architectural practice	11	11
Consultancy	536	519
Industry and Commerce	262	248
Education	184	168
Public Authority	389	362
Research and Development	170	159
Other	48	47
Retired	57	51

members (eg Institute of Physics members).

Proposed acoustics research topics for inclusion in the EPSRC list have been organised under five headings (Acoustical Phenomena; Acoustical Devices and Measurements; Acoustics-Applied; Acoustical aspects of Physiology; and Acoustical aspects of Psychology). These were submitted to EPSRC and we await their response.

The Institute has collaborated with the EPSRC in generating a list of eligible grants including all aspects of acoustics. The list is being used to generate a programme for the Institute Spring Meeting in 2002 (by inviting poster contributors to also present a paper) as well as to generate a list of posters. The Theme Day offers a significant opportunity for UK acoustics research.

SPECIALIST GROUPS

The Institute reflects the broad spectrum of the science and application of acoustics and several groups have been formed to foster contacts between members of the various specialisms.

Building Acoustics Group

During 2001 the Building Acoustics Group held two one-day meetings on the proposed revised Building Regulations (part E) at the Building Research Establishment in Watford (January) and at Salford University (April). Both meetings were very well attended by academics, consultants and members of the Construction Industry.

Each meeting began with an overview of the proposed regulations followed by an extensive question and answer session chaired by Professor Craik. These sessions engendered a lively debate on the issues and each section was followed by a vote on the views of the members. Following these meetings the Institute (through the chair of the Group) collated the views of Institute members - in particular those who attended the meetings - with a formal response being sent to the DETR as part of the consultation exercise on the regulations.

As part of the April meeting an AGM was held to review the Group's activities, identify topics for further meetings and to deal with Group business.

Preparations were made for a master-class on BS EN 12354 (for the estimation of sound transmission in buildings) to be held in London in January 2002 and for a meeting on Auditorium Acoustics to be held in July 2002.

Electroacoustics Group

The principal activity of the Group was organisation of the Reproduced Sound 17 conference held in November at the Stratford Victoria Hotel, Stratford-upon-Avon. The conference attracted 85 delegates, including several from mainland Europe and quite a contingent from the USA. Most took up the accommodation package at the hotel with the result that the usual camaraderie and bonhomie for which the Reproduced Sound conferences are known was present in no small measure. This, combined with a packed programme of exceptionally high quality technical papers, combined to

produce one of the best Reproduced Sound conferences for several years and thanks are due to the conference Committee, under the Chairmanship of Robin Cross, for the superb programme.

During the year the possibility of holding Reproduced Sound 18 in Dublin was explored as a means of involving the Irish Branch in one of the Institute's mainstream events. A joint Committee was formed with six members of the Irish Branch and the Chairman and Chief Executive travelled to Dublin for an initial exploratory meeting to evaluate potential conference venues. Unfortunately the costs of holding the conference in Dublin proved too high and the project had to be abandoned. It is now proposed to arrange a one-day meeting on the European Noise Directive instead, with keynote papers by leading mainland speakers in this area.

The Group AGM was held during the conference and, with one or two changes, most of the Committee was re-elected. The exceptions were Alan Mornington-West who stood down due to a combination of workload and poor health, and the Group Secretary, Professor James Angus who, with his move to Salford during the year, felt it was time to stand down. The appointment of a new Group Secretary was held over until the next meeting of the Group due in January 2002. As a result of the Dublin venture having to be aborted, Reproduced Sound 18 will now be held for the fourth consecutive year at the Stratford Victoria Hotel, Stratford-upon-Avon in November 2002.

Environmental Noise Group

The Environmental Noise Group continued to maintain its momentum during 2001. The Group jointly organised the Autumn Conference at Stratford-upon-Avon with the Industrial Noise Group, and this proved to be a great success. In addition, seminars/workshops on the usefulness and scope of BS 4142 were held at Basingstoke and Strathclyde University, and were well attended. Lively discussions provided useful feedback, which was passed to the BSI Committee which deals with BS 4142.

The Working Party which is drafting the Code of Practice on the Control of Noise from Pubs and Clubs continued to meet on a regular basis and it is hoped to issue a final document soon. The Group continues to provide significant input to the joint IOA/IEA Guidelines on Noise Assessment. Slow but sure progress is being made on this document and a consultation draft should be issued in the near future. Towards the end of the year, Dawn Connor, who not only acted as the Group's Secretary but also organised meetings at Basingstoke, stood down from the Committee, as she and her husband were retiring to France.

Industrial Noise Group

The Industrial Noise Group held a very successful one-day meeting over the summer entitled: What's all the noise about (WATNA I), which set the scene for a series of planned one-day meetings on industrial noise information and control. WATNA II was also intended for 2001 but for various reasons has had to be rescheduled for 2002.

The Committee produced three newsletters covering all its activities and plans plus other items of interest. The Group is also moving towards substantially up-grading its presence on the Institute's website. Communication formed a major part of a big effort to reconsider the Group's mission and basic reason for existence. A routine Committee meeting was almost entirely given over to a highly creative session where the Committee discussed what the purpose of the Group really was, rejecting all preconceived ideas of what Specialist Groups 'normally' or 'should' set as their aims. Much of this was based upon a detailed survey of members where their views of what they wanted were examined in some depth. A detailed list of standards used in industrial noise is being drawn up and will be ready for release in early 2002.

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Measurement and Instrumentation Group

The Group continued to thrive during 2001 and arranged two successful one-day meetings and jointly organised the Autumn Conference. To verify or not to verify - that is the question on the real or perceived need for correct testing and verification of sound measuring instruments and their accessories was the first one-day meeting for the year. Some 37 delegates came to the Royal Society in London in February to hear a variety of presentations on the need for correct and accurate testing and calibration of sound measuring equipment, the pitfalls that could be met along the way, especially where the question of measurement uncertainty reared its ugly head, and the best ways of avoiding most of them.

The second one-day meeting, Long term noise monitoring - just for the SEL of it?, attracted 68 delegates to the Thistle Hotel at East Midlands Airport in June, which shows that topics being selected by the Group's Committee are proving relevant to today's acousticians. These were biased towards aircraft noise measurement and prediction, but aspects of remote instrumentation were also discussed in detail. The Group's AGM was held after this meeting with no change to the Committee membership occurring.

For the first time the Group assisted in the organisation of the Autumn Conference at Stratford-upon-Avon in November. The two day conference was jointly organised by two members of both the Measurement and Instrumentation Group and the Environmental Noise Group, and produced a record attendance of 126 for the 22 papers. Noise mapping featured prominently on the first day, but many aspects of both noise and vibration

measurement filled the second. The quality and variety of the papers were uniformly excellent and made for a very worthwhile event.

In October, the Committee was sad to lose its first and only Secretary, Peter Hanes, as he emigrated to commence a new job in Canada. His sterling work will now be in the capable hands of Martin Armstrong. For 2002, three one-day meetings are in preparation.

Musical Acoustics Group

The Musical Acoustics Group had another quiet year and was not involved in any conferences or meetings. However, the Group has been working towards implementing the follow-up actions arising out of the 1999 Industry Focus Meeting on Musical Acoustics held in Edinburgh. In particular a report on the meeting has been submitted to EPSRC (Engineering and Physical Science Research Council) who funded it, and we have transcribed the recordings of all the talks and presentations in order to produce a more complete publication. Our current activities are aimed at organising a musical acoustics session at the Institute's 2002 Spring Conference and Theme Day.

Joint IOA/IOP Physical Acoustics Group

This was another successful year for the Group. The Committee met four times during the year and published a Group Newsletter in September. The highlight of the year was the first Anglo-French Physical Acoustics Conference 2001 (AFPAC'01) which took place in December at Wye College in Kent. This was a joint event between the Group and the corresponding specialist Group of the Societe Francais d'Acoustique, which was combined with the traditional Group AGM.

The Conference attracted about 70 participants from both UK and France, who delivered six invited and 33 contributed talks. The high level of presentations and the informal atmosphere during and after sessions made this event a great success. It has been decided to continue this series of Anglo-French conferences annually, with the next event being held in France in the year 2002. Another event in which members of the Group actively participated was a one-day meeting in November on Simulation and Modelling in Medicine, held in London.

Speech Group

The two-day Workshop on Innovation in Speech Processing (WISP) 2001 introduced a new format for the Institute's main speech event, replacing the biennial Windermere Autumn Conferences on Speech and Hearing. WISP was held at Stratford-upon-Avon in April and attended by 53 delegates. WISP attracted 28 papers and was organised as four half-day sessions, each introduced by a keynote lecture. There were no poster sessions and other presentations were 20 minutes each. This format has received many favourable comments. Keynote speakers were Professor Geoff Hinton of University College London, Al Gorin of AT&T Laboratories, Professor Chris Darwin of Sussex University, and Deb Roy of the MIT Media Lab. The first session concentrated on pattern matching algorithms for automatic speech recognition. The second combined papers on recognition of natural dialogues, speech recognition and speaker verification in noise, and linguistics.

The third session was concerned with human perception and prosodic, durational and segmental recognition. This was very much in keeping with the Speech Group's multi-disciplinary emphasis. The keynote for the final session was on spoken language acquisition by a robot, equated to a baby learning in a play environment. Other papers were on acoustic analysis of speech signals.

During the year Dr Stephen Cox, the Chairman of the Group, resigned and no further meetings of the Committee have taken

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place. It is hoped that the Group will become active again in 2002.

Underwater Acoustics Group

The Committee held regular meetings throughout the year, and expanded its experience base and number. During 2001 it was involved in the organisation of two major international conferences.

The first was Acoustical Oceanography, held in April at the Southampton Oceanographic Centre and supported by DERA. Over eighty delegates from a large number of countries supported this international meeting. Subjects ranged from low frequency large-scale ocean acoustics to short range Megahertz frequency scattering by marine suspensions. During the conference the A B Wood Medal address was given by Gary Heald. The conference was interesting, exciting and challenging, and supplemented by an excellent conference dinner on HMS Warrior.

The second conference, held in July at Loughborough University, was supported by the American Office of Naval Research, with 36 delegates (disappointingly fewer than expected) and included the A B Wood Medal address, given by John Colosi. The topic was the developing area of Underwater Bio-Sonar Systems and Bioacoustics. The ever increasing scientific and public interest in the interaction between human activity and the marine environment has led to enhanced priorities in all aspects of underwater bioacoustics. This meeting, which covered areas from sound production and reception mechanisms in marine organisms, to the classification and analysis techniques for bioacoustic signals, aimed to review the present state, examine future trends and provide a forum for discussion on the important and sensitive area of underwater bioacoustics.

Future plans for 2002 include a session at the Institute's Spring Conference and Theme Day in March and a meeting on Calibration at NPL in the summer (a tutorial day and a day of contributed papers). In 2003 the Group hopes to continue its tradition of regular meetings on Sonar Signal Processing and on Underwater Transducers. Dick Hazelwood has been co-opted to the Committee to represent industrial interests and Dave Goodson is continuing as a co-opted member after his successful organising of the conference at Loughborough. The membership of the Committee is otherwise unchanged.

REGIONAL BRANCHES

The Regional Branches of the Institute have been established to further the technical and social activities of the Institute at local level.

Eastern Branch

The Eastern Branch had a good year with seven technical meetings organised from five Committee meetings with a slightly lower average attendance of around 17. As always, the Committee tried to provide a wide cross-section of topics with venues spread across the Eastern Region. The first meeting was a visit to a pipe organ designer and manufacturer in Ipswich, where John Bailey conducted an interesting tour. This was closely followed in March by a very successful afternoon meeting at Ipswich where David Ormandy, Dani Fiumicelli and Ian de Prez discussed with members and non-members Poor sound insulation of residential premises (re Baxter and Mills). In April Les Fothergill gave an illustrated talk at Braintree on the Proposals for amending Building Regulations Document 'E'. We were highly delighted to host a talk by Mark Tatham at the University of Essex when he demonstrated the difficulties in Getting computers to talk. With no major interest in the planned social event for this year, our Branch members returned in September to enjoy a talk by Roger Higginson on Regulations and standards for machinery noise emissions at Colchester, which was followed in October at Colchester by a very interesting insight into The development of a guide to

TABLE 5: MEETINGS ATTENDANCE IN 2001

Topic, date and venue	attendance
Approved Document E of the Building Regulations 31 January, BRE	138
To verify or not to verify - that is the question 14 February, London	39
The emerging role of BS4142 8 March, Basingstoke	60
Workshop on innovation in speech processing 2 April, Stratford-upon-Avon	54
Approved Document E of the Building Regulations 3 April, Salford	60
Acoustical oceanography 9-11 April, Southampton	87
Noise in London 23 May, London	78
Long term noise monitoring - just for the SEL of it? 6 June, East Midlands Airport	68
The emerging role of BS4142 19 June, Glasgow	39
Machines - what's all the noise about? 28 June, Port Sunlight	59
Underwater bio-sonar systems and bio-acoustics 23-24 July, Loughborough	38
Autumn Conference - Measurement and assessment of environmental noise 14-15 November, Stratford-upon-Avon	129
Reproduced Sound 17 16-18 November, Stratford-upon-Avon	85

uncertainties in environmental noise delivered by Geoff Kerry. Our AGM was combined with our final meeting in November at Braintree where Ken Dibble addressed methods of assessing the Noise from pubs and clubs.

Irish Branch

The first Branch Meeting of the year was held in March, commencing with dinner, after which Ken Dibble delivered a paper on Noise from entertainment premises, which provoked much thought and discussion. The AGM followed at which two new Committee members (Sam Bell and Heather Armstrong) were elected and Kevin Chambers who had been Honorary Treasurer since the inception of the Branch stood down due to work commitments.

A seminar on workplace noise delivered by David Bull in September, in conjunction with the H&S Executive for Northern Ireland and the Industrial Research and Technology Unit, attracted considerable interest from industrialists. In December, to overcome difficulties of geographical separation of members, meetings were held on consecutive days in Dublin and Belfast at which Ian Campbell, Past President, presented a paper entitled Modern methods of sound measurement. These events represented a considerable commitment by both Ian and the Branch Chairman and were greatly appreciated by members. An approach was made to the Association of Professional

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Engineers in Ireland (APEI) which led to an insertion in the current APEI Yearbook which publicises the activities of the Institute of Acoustics and the local Branch. During the year a Committee was formed to consider the possibility of holding a Reproduced Sound conference in Dublin during 2002 but due to cost implications this was not possible. The Branch Committee met on three occasions during the year. A provisional programme has been arranged for 2002.

□ London Branch

The interesting and diverse range of subjects encompassed within the Institute of Acoustics was amply demonstrated by the wide range of topics discussed at this year's London evening meetings. As an example, at the beginning of the year, the talk was on rodents and ultrasound, whilst in December the subject matter was the sound of bells. As usual, the London Branch of the Institute of Acoustics can report another busy year consisting of a successful one-day conference, an interesting half-day visit, the annual dinner and a full programme of evening meetings.

A total of nine events were held throughout the year. These included five evening meetings held at Symonds offices in London, a half-day visit to the BBC at Broadcasting House, a one day-conference held at the Commonwealth Conference Centre and our annual dinner held at South Bank University. Attendance at the meetings and functions was good and generally on a par with previous years' attendance figures, ranging from 20 to 50 members per evening meeting. It has been noticed that there is a general core group of members (10 to 20) attending these meetings on a regular basis, with the remainder made up of new attendees or people who attend occasionally depending upon the topic under discussion. The half-day visit attracted some 50 members and was again over-subscribed. The visit was to the BBC's Broadcasting House in Central London where we were made most welcome by hosts who showed us the various technical radio facilities. This included a tour of the 'live' theatre and visits to the Radio 2, 3 and 4 studios. We were also lucky enough to witness 'live' broadcasting at various times, being able to discuss operational and technical issues with producers and presenters.

Noise in London was the subject of our one-day conference, which like the half-day visit was over-subscribed. The meeting was opened by a note which had been prepared by The Mayor, Ken Livingstone, followed by a host of interesting papers related to experiences in London, the UK and overseas. The conference was fortunate to have George Vulkan present a paper on the early days of tackling noise problems in London, followed by Stephen Turner presenting the current issues, with Max Dixon giving an insight into the GLA noise strategy. Other papers included a review of the National Noise Incidence Study, noise strategies in other overseas cities as well as many other related aspects. The conference was a major success and was brought to its conclusion by the Rayleigh Medal lecture delivered by Victor Krylov.

An entertaining evening was enjoyed by all at the annual dinner held in November at South Bank University. There was a pleasant atmosphere in the restaurant with good quality food and exceptional service. The evening was completed by Derek Sugden's entertaining after-dinner speech. A full programme is being planned for this forthcoming year and the Committee looks forward to the continued support from members and friends.

□ Midlands Branch

The Midlands Regional Branch held four evening meetings and one half-day visit in 2001. The first evening meeting was held in March at the Old Council House, Coventry when Matthew Ling

of BRE spoke on the planned changes for 'Approved Document E' under the title Where now for the Building Regulations. In May, Brian Hemsworth gave a very informative talk on Recent developments in noise control for European railways at the University of Derby.

After a summer break the autumn programme resumed with a talk entitled: Blasting explosives or blasted explosives, on the noise implications of quarry blasting. Tim Wilton of Vibroc gave this talk in October at the University of Loughborough. The final evening meeting was combined with the Branch AGM in November at the University of Birmingham, when Ron Hawkes of W S Atkins spoke about the EU directive on: The assessment and management of environmental noise.

The half-day meeting to Birmingham Airport was planned to include a tour of the airside operations but the date of the visit was too close to the 11 September attack on the World Trade Centre to allow this to go ahead. Nevertheless, the visit was a success due to the efforts of airport staff in providing an entertaining and informative time. A similar programme of meetings and a visit is planned for 2002.

□ North-West Branch

Another busy year of meetings for the NW Branch started in January with a helpful and practical talk by John Baitty, Clarke Energy, on noise control for fans and CHP plant. This was followed in March by a joint presentation by Iain Critchley, Peninsular Acoustics, and Geoff Chisholm, HSE, who stood in at short notice after Mike Hewett, AV Technology, could not attend. The subject was hand-transmitted vibration and its potential effect on upper limb disorders.

A very well attended half-day workshop/meeting was organised by Nick Antonio, Arup Acoustics, and held at Salford University in April. Introduced by Professor Bob Craik, Heriot Watt University, and Dr Les Fothergill of DETR, and shared with the Building Acoustics Group, the implications of the proposed changes to the Building Regulations were thoroughly aired. The assessment of noise from wind turbines was the subject of a presentation in May by Malcolm Hayes, Hayes McKenzie Partnership, which provided the background to the ETSU report. In June, a joint presentation by Jonathon Lawton, a solicitor, and Jo Webb, Arup Acoustics, was held on noise aspects of HGV operator licensing and advice on providing expert evidence. The 'social event' of the year was an opportunity to scale the highest mountain in the world with a viewing of 'Everest' at the UCI Printworks organised by Paul Freeborn, Casella Stanger. After a visit to the projection room, Peter Sacre, Acoustic & Engineering Consultants, gave a brief introduction to acoustic design in cinemas. The AGM was held in October with Ian Campbell, Past President, providing a personal review of noise control regulation over the past 35 years.

In November, Dr David Hiller, Arup Acoustics, gave a talk on vibration in construction works, outlining limits and measurement methods. In December, the final event of the year, held in Lytham St Anne's and organised by Geoff Kerry, President Elect, and John Houldsworth, Sound Advice, was a forum to provide an opportunity to discuss any acoustics issues and to bring the Branch closer to the members.

□ Scottish Branch

2001 saw changes in the Scottish Branch Committee. Both John Nicol and Bill Frame, who had been sharing the post of Secretary, had to step down due to work pressures. The role has now been filled by Lillian Lauder. Sean Smith has also joined the Committee. We welcome both members and are looking forward to their contributions to the Branch in the future. Three meetings were held this year, the first in April at DERA,

Rosyth. Mitch Penman and George Duncan gave excellent presentations on Noise control in a naval environment. The AGM was held after this meeting. In June, the Branch, together with the Environmental Noise Group, held a meeting at the University of Strathclyde to determine views on what the BS Committee should pay most attention to when it considers the next revision of 4142. The intention was that views collected could be fed into the BS 4142 EH/1/3 meeting. Nigel Cogger, Ian Flindell and Colin Cobbing gave presentations and Bernadette McKell chaired the meeting. There was a very good attendance and some very lively debate at the end.

The third and final meeting was on the subject of Taking the sound insulation of windows into the 21st Century. Cliff Inman gave a fascinating presentation to a small but very lively audience. The subject was clearly close to the heart of many present, as the questions were endless (Cliff answered them all). Given that the meeting was held in late December, most of those present then made their way to a Merchant City restaurant where the problems of the acoustic world were solved.

☐ Southern Branch

The Branch held one meeting in 2001 - a presentation by Geoff Leventhall on Low frequency noise at the offices of the Basingstoke and Deane Borough Council - attended by 21 members. After an introduction to sources and mechanisms of propagation, Geoff discussed the human perception of low frequency audible sound and infrasound and the various criteria in use. The formal presentation was followed by a stimulating question and answer session.

The Chairman, Dawn Connor, who retired from Basingstoke and Deane Borough Council in August has moved to the peace of the French countryside. Dawn made an invaluable and very active contribution to the Southern Branch over many years and she will be greatly missed. The AGM is planned for April 2002 and nominations for new Committee members are invited.

TABLE 6: INSTITUTE PERSONNEL AT 31 DECEMBER 2001

COUNCIL		
Officers		Ordinary Members
President	Professor M A A Tatham FIOA	Professor R J M Craik FIOA
President Elect	Mr G Kerry FIOA	Professor B M Gibbs FIOA
Immediate Past President	Mr I J Campbell MIOA	Mr C J Grimwood MIOA
Honorary Secretary	Dr R A Orłowski FIOA	Professor T G Leighton FIOA
Honorary Treasurer	Mr K Broughton MIOA	Dr G C McCullagh MIOA
Vice Presidents		Professor B M Shield FIOA
Engineering	Mr C E English FIOA	Mr A W M Somerville MIOA
Groups & Branches	Mr D G Bull FIOA	Mr S W Turner FIOA
International	Mr B F Berry FIOA	Dr T J Cox
Committees and sub-committees		
Education		Chairman
Diploma in Acoustics and Noise Control, Board of Examiners		Dr M E Fillery FIOA
Certificate of Competence in Environmental Noise Measurement		Professors K Attenborough FIOA
Certificate of Competence in Workplace Noise Assessment		Mr D Trevor-Jones FIOA
Certificate in Measurement of Sound Transmission in Buildings		Mr A E Watson MIOA
Certificate in Management of Occupational Hand Arm Vibration		Professor R J M Craik FIOA
Engineering Division		Mr T M South MIOA
Medals & Awards		Mr C E English FIOA
Meetings		Professor M A A Tatham FIOA
Membership		Mr S W Turner FIOA
Publications		Mr J R Dunn MIOA
Professional Development		Mr J G Miller MIOA
Research Co-ordination		Ms S M Bird MIOA
		Professor K Attenborough FIOA
Specialist Groups	Chairman	Secretary
Building Acoustics	Professor R J M Craik FIOA	Mr S G Chiles MIOA
Electroacoustics	Mr K Dibble FIOA	vacant
Environmental Noise	Mr K M Collins MIOA	Mr N D Cogger FIOA
Industrial Noise	Mr A R Raymond MIOA	Mr M D Hewitt MIOA
Measurement & Instrumentation	Mr R G Tyler FIOA	Mr M Armstrong
Musical Acoustics	Dr P F Dobbins FIOA	vacant
Physical Acoustics (joint with the Institute of Physics)	Mr D Cartwright	Dr N Saffri
Speech	vacant	Dr A P Breen
Underwater Acoustics	Mr J R Dunn MIOA	Dr P D Thorne FIOA
Regional Branches	Chairman	Secretary
Eastern	Mr J M Hustwick MIOA	Mr M P Alston MIOA
Midlands	Mr J F Hinton MIOA	Dr M E Fillery FIOA
Irish	Dr G C McCullagh MIOA	Mr J O Hetherington MIOA
London	Mr J E T Griffiths FIOA	Mr A J Garton MIOA
North West	Mr P E Sacre MIOA	Mr P G Michel MIOA
Scottish	Dr B McKell MIOA	Ms L Lauder AMIOA
Southern	vacant	Dr N D Cogger FIOA
South West	Mr T Clarke MIOA	Mr S Simpson MIOA
Yorkshire and Humberside	Mr R F Scott MIOA	Mr T M South MIOA

☐ South West Branch

During 2001 the South West Branch had another fallow year with no meetings. Future meetings in 2002 are intended and these will be focused on the practicalities of noise mapping. The Committee remains the same as that elected/co-opted in December 2000 namely Tim Clarke (Chairman) Stan Simpson (Secretary), Steve Peliza (Treasurer), Peter Dobbins, Graham Rock, Mike Squires and Paul Marks.

☐ Yorks and Humberside Branch

Yorkshire and Humberside Branch did not hold any meetings during 2001, but has a series of activities planned for the early part of 2002.



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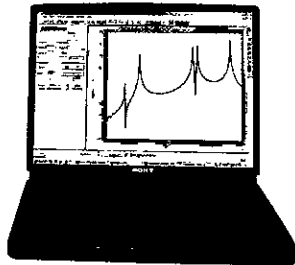


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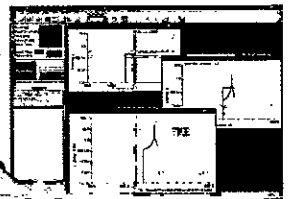
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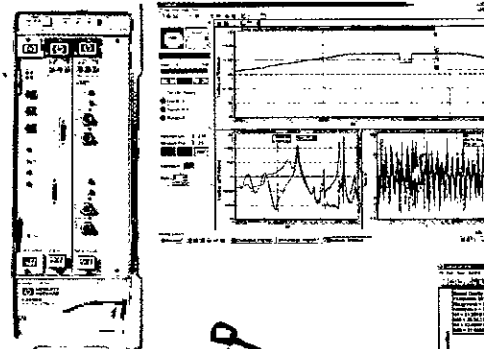


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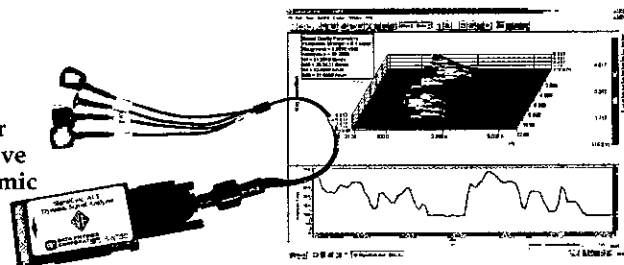


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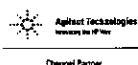


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SPRING CONFERENCE REPORT

Building and Environmental Acoustics

The Building and Environmental Acoustics sessions were jointly organised by the IOA and ENABLE, a network of academic research institutions funded by EPSRC. There were three formal papers and one informal presentation on the first day.

The first paper, by **Ray Kirby** and **Jane Lawrie**, was concerned with assessing the effectiveness of silencers. A computationally efficient method of assessing acoustic attenuation was described based on finite element methods. This new method agreed well with more exact analytic models. Current attenuations are conservative but there has not yet been any experimental data.

The second, by **Richard Lyons** and **Jane Horner**, looked at predicting reflection and scattering around an aperture in a wall such as the termination of a ventilation duct. The model described allows the effect of parameters such as part ratio or perimeter to be assessed and provides a guide for practitioners.

The final formal presentation, by **Sophie Maluski** and **Barry Gibbs**, discussed sound transmission at low frequencies investigated using finite element methods. The model included furnishings and wall absorption and enabled mode coupling to be determined. There was good agreement between the FE predictions and experimental results.

The Monday session ended with a short update by **John Sellar** of the BRE on the proposed changes to the Building Regulations and Approved Document E. The BRE reviewed about 200 responses. The final document has changed since initial consultation and is expected to be released in Summer 2002. ISO 140 is being revised and a summary of those changes was described.

The session resumed on Wednesday with a paper by **Ning Qi**, **Andy Moorhouse** and **Barry Gibbs** examining the acoustic, fluid and structure-borne power radiation from a pump. It showed how the power components can be determined, and how they may be related to the same physical cause.

The second paper, by **Julie Dockrell** and **Bridget Shield**, looked at the perception of children to noise in classrooms. A detailed questionnaire survey of both children and teachers showed which sources can be heard and which cause annoyance. As a paper had been cancelled, a lively discussion continued for 15 minutes after the presentation.

The third paper, by **Richard Collman**, discussed the wide range of assessment parameters and situations and suggested how a more consistent approach to regulations and measurement might be undertaken.

The final paper, by **Laurent Galbrun** and **Bob Craik**, examined the complex

problem of vibration transmission in timber framed buildings. It was found that the simple models for coupling all junctions were insufficient for real junctions.

Y K Lam then took the opportunity to outline the EPSRC-funded network on acoustics, describing the aims of the network and the developing links with industry. Further details are available at www.enableacoustics.org.uk.

Robert Craik

Room Acoustics

Wednesday's room acoustics sessions offered a diverse range of subjects. **Jian Kang** from the University of Sheffield talked about improving the acoustics of dining spaces, especially speech intelligibility. The study used a validated geometric model. The signal to noise ratio seemed to be most critical. The key seems to be correct use of sufficient absorbent; but will the architects use this simple solution?



The Conference's trade exhibition

Trevor Cox from Salford University discussed the design of binary amplitude diffusers. Previous work on these surfaces had made many assumptions to allow easy prediction and design. Trevor was able to show that many of these were, in fact, correct. Preliminary Boundary Element Method predictions were shown illustrating the diffusion performance.

Darren Ward from Imperial talked about cancelling cross talk for 3D audio. The problem is getting these systems, originally designed for anechoic conditions, to work in reverberant spaces. In the presence of interfering reverberation, the cross talk filters appear to be significantly less effective, but fortunately, the precedence effect may come to the rescue and the results may be subjectively less important than at first appears.

Steve Dance gave a presentation concerning the accuracy of geometric computer model predictions for rooms with large amounts of absorption. The reliability of standards on Sabine's equations results in inaccuracies, and the Millington equation was suggested as more accurate.

Joko Sarwano from Salford University talked about the design of Javanese Gamelan concert halls. To overcome the lack of expert listeners in Salford, Joko had bravely attempted subjective tests across the Internet for the preferred level of reverberation. Similar results were found from the Internet experiment as a controlled laboratory experiment; a preferred RT of about 0.5s.

Ingyn Chun from ISVR looked at spatial correlation in a reverberation chamber to validate theoretical broadband formulations. Excellent accuracy is found above the Schroeder frequency, but at lower frequencies where individual modes dominate, the formulations are less accurate.

Mark Lawson from Reading University investigated how the location of objects is achieved by people with a visual impairment, especially in reverberant conditions. There are 1-2 million people with a visual impairment in the UK, and so room acoustic conditions need to be improved for inclusive design. Two groups of subjects were tested, with and without visual impairment, and found to perform similarly.

Stuart Colam from ISVR investigated a bass absorber design used in recording studios following a non-environment design. An FEA model had been used to investigate a horn effect present. Stuart showed that pressure discontinuities, leading to high particle velocity through porous absorbent, was responsible for high absorption.

Ian Drumm from Salford University discussed adaptive beam tracing as a system to get a geometrically perfect specular room model. It runs faster than other techniques, but is difficult to implement. Problems, such as characterising the properties of the materials on the room boundaries, are common to other geometric models.

Mike Barron from Bath University talked about ISO 3382, the measurement of reverberation time in rooms with reference to other acoustic parameters. Better guidance is needed in reporting results, and careful consideration of stage conditions during testing are needed. What is not needed is more objective measures!

Trevor Cox

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SPRING CONFERENCE REPORT

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Transportation Noise

The transportation noise session included contributions on road, rail and air transport with particular emphasis on control of key sources. **Greg Watts** from TRL opened the session with a presentation on the assessment of noise barrier diffraction using an in-situ measurement technique. This relies on quantifying the diffraction efficiency in the near field using an MLS method. This included test results of a series of novel barrier designs. Differences of several dB were seen between them with absorbent T-shaped and multiple edge profiles performing best.

Greg Watts presented a second paper on the dynamic measurement of the sound absorption of porous road surfaces. A measurement method is proposed using a trailer with a loudspeaker and microphone from which the absorption properties of the road surface are determined at speeds up to 30 km/h. For absorbent road surfaces this gave results that agree reasonably well with static measurements. It can be used to monitor the deterioration of the surfaces over time.

Mike Brennan of ISVR then presented an orthotropic plate wave model for the dynamic response prediction of a pneumatic tyre. The vibration of a tyre is modelled using a modal expansion around the circumference and a simple plate wave model across a section. Particularly above 500 Hz, where finite element models are unsuitable, good agreement with measurement data has been found.

David Thompson of ISVR concluded the session with the only railway noise paper of the conference. This discussed the use of vehicles with small wheels for determining the component of noise from

the track, using the TWINS model to study different wheel designs. The application is within an EU project where experimental methods are being developed to separate the contribution to wayside noise from the vehicle and the track. The simulations showed that this was not without difficulty. The session resumed on Wednesday with a paper by **Jeremy Astley** of ISVR on research in aero-acoustics at the ISVR. This reviewed the work of the Rolls Royce UTC for Gas Turbine Noise established in 1999. He concentrated particularly on what he had called the 'killer problem' of numerical acoustics - calculations of sound radiation from inlets (and outlets) of jet engines, for which finite and infinite elements are used.

Chris Morfey of ISVR spoke next on aero-acoustic source terms in turbulent flow: direct numerical simulation results. Large computational fluid dynamics calculations, running in one case to 95,000 cray-hours, were used to provide a 'computational laboratory'. The results demonstrate that not only a quadrupole but also a dipole component of radiation is present when a turbulent boundary layer flows between two rigid surfaces. Although this is inconsistent with much published work it appears to be a genuine phenomenon.

Concluding the trio from ISVR, **Phil Joseph** presented a paper on in-duct pressure measurements for sound power determination in flow-ducts. In the presence of flow, sound power is not simply related to pressure as in the zero flow case. The study looked at the sensitivity to source distribution, frequency and flow speed and found considerable effects, backed up by experimental results. This has applications for aero-engines as well as many other types of duct.

David Thompson

Physical and medical acoustics

There were nine presentations in this joint session, of which eight were on *Physical Acoustics* and one on *Medical Acoustics*. In the first talk, 'Acoustic black holes for flexural waves and their potential applications', given by **Prof Victor Krylov** of Loughborough University, the new type of flexural vibration absorbers was described that uses some specific wave propagation properties of elastic wedges having a power-law profile.

For example, in an ideal wedge of a quadratic shape the incident flexural waves can become trapped near the edge and never return. This means that the above structures materialise acoustic 'black holes' for flexural waves. Unfortunately, because of the deviations of real manufactured wedges from the ideal power-law profiles, the corresponding reflection coefficients are always far from zero.

Victor showed theoretically that the situation can be improved significantly by depositing absorbing polymeric layers on the wedge surfaces. Thus, the combination of the power-law profile and of thin absorbing coating can lead to the development of a new generation of effective vibration absorbers. This research is still in progress, especially in respect of its experimental validation.

In the second paper, **Prof. Peter Cawley** of Imperial College, described the recent results he and his colleagues obtained on the effect of soil properties on dispersion characteristics of acoustic and elastic waves propagating in buried iron water pipes. The results of this research are expected to be used for the improvement of acoustic leak detection techniques.

Also, it is important to know whether examination of the dispersion curves extracted from test data can give information on pipe characteristics such as diameter, material and wall thickness.

ANC PRIZES 2000-01

Each academic year the **Association of Noise Consultants** awards two prizes; for the best IOA diploma project and for the best paper presented at an IOA conference by a young acoustician. Both prizes were presented by ANC Chairman, **Phil Dunbavin**, during the Spring Conference at Salford University.

The prize for the best paper by a young acoustician was awarded to **Nigel Milton** of NPL for his paper, 'A system for the verification of interfaceable sound level meters' which he presented at the IOA Measurement and Instrumentation Group's 'To verify or not to verify' meeting. Nigel's £250 prize included his book choice - *Book of Science*.

Nominations for the 2001-02 prize have already been received for some sessions at the Spring Conference and all IOA meeting organisers and chairmen are strongly urged to make nominations to the IOA office after each meeting. The prize is then



judged on the written paper. The IOA put forward a large number of diploma project reports for consideration, all of a very high standard. The eventual winner was **Adrian Morgan** for his project, 'Evaluation of sound absorbency of Owens Corning Alcopor UK Ltd insulation products'. Adrian's choice of book, *Noise*

Control in Building Services, was kindly donated by an ANC member company, Sound Research Laboratories, which he received in addition to the £200 prize.

Pictures show (left) **Nigel Milton** and (below) **Adrian Morgan**, receiving their prizes from **Phil Dunbavin**



Theoretical calculations were compared with experimental results obtained from operational water mains in the London area. In a paper prepared by **O Umnova** and **K Attenborough** of Hull University, Dr Olga Umnova discussed results on the use of a theoretical approach for predicting the drag parameters of air-saturated fibrous absorbents with fibres oriented either normally or parallel to the direction of sound propagation. The expressions for different drag parameters (permeability, tortuosity, etc) were derived for both monodisperse and polydisperse arrays. Comparisons between cell model predictions, numerical results and various experimental data were discussed.

Richard Brind's paper gave an insight into the problem of portable humanitarian landmine detection and proposed different techniques employing acoustic principles. These included using surface acoustic waves propagating in the soil, non-linear acoustic reflection of air-borne sound from the mine, and changes in linear acoustic impedance. It was pointed out that so far no single method has proved absolutely superior. The research in this area is now quickly progressing in many laboratories around the world.

Glen McHale presented a paper co-authored with **M I Newton**, also of Nottingham Trent University. He described the use of Love surface acoustic waves in acoustic chemical sensors based on the absorption of liquid or gas particles by a sensitive layer deposited on the surface of an elastic plate. The dispersion curves of Love type waves propagating in such layered plates were calculated and discussed.

Glen demonstrated that the highest sensitivity of the corresponding acoustic sensors can be obtained for higher order Love modes at frequencies associated with the largest values of slopes in the dispersion curves.

Taking the theme, 'Acoustic aberrations and adaptive acoustics', **Matthew Clark**, University of Nottingham, pointed out that it is still not well appreciated or understood that acoustic aberrations play a major role in many acoustic measurement systems. In particular, acoustic aberrations that arise from material micro-structure can be performance limiters in many types of ultrasonic inspection.

The detrimental effects of acoustic aberrations can reduce the resolution and reliability of many systems, often before scattering and absorption become significant. The experimental evidence to support this work was presented using the adaptive optical scanning acoustic microscope system (AOSAM) at Nottingham University.

In the paper of **George Kakarantzas et al**, University of Bath, discussion focused on the acousto-optic interaction in optical fibres. The difference of the proposed system from traditional acousto-optic systems using crystal samples is in its high efficiency and sensitivity.

The acousto-optic interaction in such systems was used to demonstrate a number of all-fibre devices, such as frequency shifters, filters and optical switches. The physics of acousto-optic interactions in optical fibres together with some recent

results and potential applications were discussed and reviewed.

The only medical acoustics paper in the session, 'Enhancement of cardio-respiratory function and neurological development in pre-term infants using acoustic-vibro stimulus', was presented by **Dr Sean Smith**. According to previous works, the VIII cranial nerve (auditory nerve) may play a key role in controlling cardio-respiratory function and maturation of neuro-synaptic junctions of pre-term infants.

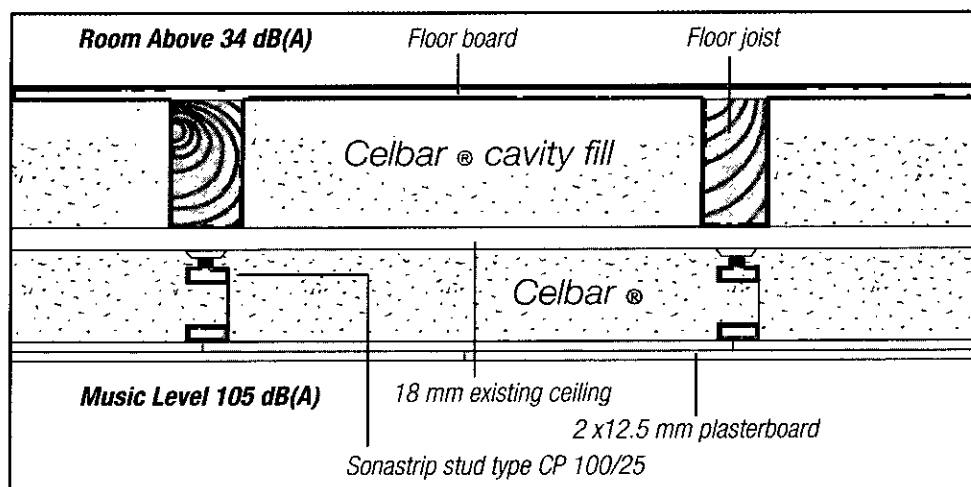
Currently pre-term infants are provided with temperature comfort, oxygen and fluid nutrients, but may lack the acoustic vibro-stimulus as experienced intrauterine. Sean described how future research in the acoustic field could lead to a reduction in abnormalities experienced by pre-term infants by introducing in the critical early postnatal period an artificial acoustic intrauterine environment.

Finally, **Dr Kyrill Horoshenkov** of Bradford University presented 'The sound speed and attenuation in porous cements' (the co-authors were D C Hughes, also of Bradford University, and A Cwirzen of Helsinki University of Technology). This paper studied sound propagation and attenuation in high-alumina-based porous concrete which can be used for the development of acoustically efficient and structurally robust building materials.

Values of porosity, flow resistivity, tortuosity and parameters of the pore size distribution had been determined and used to predict the sound speed, acoustic attenuation and normal incidence absorption coefficient of these materials.

Victor Krylov

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SCOTTISH BRANCH REPORT

Taking glazing into the 21st Century

The December meeting proved a delightful mix of technical information with seasonal and social cheer. **Cliff Inman** had kindly agreed to present a talk entitled 'Taking glazing into the 21st Century'.

He started by taking us through the basics, explaining that with single glazing it is simply a case of the more mass the better. There are two resonances to be aware of: those associated with the size and with the thickness of the panel. He was anxious to get across the message that, as all consultants will be aware, a resonance check must always be carried out. For those members unsure of how to calculate the resonances he demonstrated the use of the formula, $f_c = 12000/\text{thickness (mm)}$ in determining the resonance at 3kHz for 4mm glass and 2kHz for 6mm glass.

His talk then moved on to the use of laminates to mitigate against resonance effects. The glass/laminate/glass make-up provides an energy absorptive layer but it is only effective at the frequency of coincidence resonance.

Basically, there are two types of interlayer used in laminates: polymethyl methacrylate (pmma) and polyvinyl

butyral (pvb). There is also a new acoustic laminate which is an acoustic version of pvb. It is apparently not as good as pmma but still pretty good at low frequencies. Cliff also warned against using two panels of similar thickness in double glazed units. While there are definite advantages in using glass of different thicknesses, to be effective the difference should be about 30%. For example, 10/12/6 is OK. The effect of air gaps was also highlighted, in that gaps and bad sealing can easily reduce the insulation offered by 6dB or more. He illustrated this by showing the test results on a centre pivot window where the level of sound insulation offered was improved by 6dB simply by sticking tape over the pivot joint!

The myth of secondary glazing was exposed, when Cliff explained the levels of sound insulation achievable by means of laminates and the new acoustic laminate. A discussion then followed in relation to the appropriateness of the wording of the Schedule within the Noise Insulation (Scotland) Regulations 1975. Another point covered was the effect of the frame. Cliff demonstrated that there is no real difference as a result of the frame type up to an R_w of about 38dB.

The reference to R_w then led onto the rating system and the derivation of the R_w system was explained. The sometimes misleading use of the R_w rating system when considering the use of gas-filled units was touched on. Basically, although SF6 units get a very good R_w rating, they are very poor in terms of insulation against road traffic noise. This is because of the enhancement in the middle frequencies with SF6, but the resonance at 200Hz is missed and this has a very serious impact on noise from road traffic.

A discussion about the effects of curtain walling proved very interesting. This is a common feature in modern design and the implications of continuous mullions were discussed in some detail. The conclusion was that sometimes such glazing features can actually result in the glazing acting like a loudspeaker.

The discussion could have gone on all night, and some very interesting points were discussed, but a table had been booked at a Merchant City venue and so reluctantly we all trooped along and drowned our sorrows. A big 'thank you' is owed to Cliff, and we hope to see more Scottish Branch members at our next meeting. Details will be posted on the soon-to-be-created Scottish Branch section of the IOA web site - so keep checking.

Bernadette McKell
Chair, Scottish Branch

NORTH WEST BRANCH REPORTS

European Physical Agents Directive on Noise and Vibration

The HSE's **Keith Broughton** gave members an extremely interesting topical overview of the current (nearly finalised) Physical Agents Directive. Effectively, Directives are core EU framework instructions, enacted by member states through national legislation. The existing UK Noise at Work Regulations followed from a previous Directive and the new proposed Physical Agents Directive takes this a step further. Keith, who is the UK expert on this Directive, started by describing the major players and EU committee structures. He provided a fascinating insight into a few of the influences and interests of a number of member states.

For noise, the proposed Directive introduces the new concept of a limit value of 87dB(A) or 200Pa (a level not to be exceeded), reduces the upper action value to 85dB(A) or 200Pa, and the lower exposure action level to 80dB(A) or 112 Pa. The Directive also requires an assessment to be carried out whatever the level.

Keith went on to describe the Directive in detail, together with the thinking behind it, the timescales, how the scope was being expanded to cover workers who are currently exempt, the

additional employers' requirements, and the need for further health screening. It was interesting to see how the Directive evolved with other influences beyond the technical acoustic requirements, through the life of the process.

Hand/Arm Vibration Syndrome (HAVS) or whole body vibration is not currently covered by any existing EU Directive. A proposed Directive introduces a limit value of 5m/s² A(8) and an action level of 2.5m/s² A(8) for HAVS, and a limit value of 1.15m/s² and an action value of 0.6m/s² A(8) for whole body vibration. All the limits are in terms of the resultant sum of vibration accelerations on three orthogonal axes. Keith went into some detail describing the other requirements. These proposals are of considerable importance to a wide variety of interest groups, not least the acoustic community, and Keith answered a number of questions from the floor.

Nick Antonio

The Fylde Forum

Spurred on by the President-elect, who thinks it's time the Institute went to the members rather than the other

way round, the NW Branch committee decided on a foray into the far reaches of Lancashire to hold the 'Fylde Forum'. Thanks to the efforts of local man and ex-committee member, John Houldsworth, a convenient venue was located at the Lytham St Annes YMCA Community Centre. All members within easy reach were invited to attend, take a friend and be armed with questions on acoustics.

Some branch committee members elected to show their ignorance by volunteering to attempt answers to questions on topics such as IPPC; sound insulation in dwellings (especially conversion to bed-sits); the Building Regulations and EU policy*; and mapping.

The meeting ended with a lively discussion on teaching 'acoustics' in schools and how to get teenagers interested in pursuing a career in acoustic related areas. Our thanks go to Sound Advice who sponsored the meeting.

**On leaving the premises some of the committee remarked upon the low ambient noise level in the Fylde but rather than continue the discussion on EU 'quiet areas' they decided to head back to the Manchester agglomeration.*

G Kerry

NEW INSTITUTE MEMBERS

At Council on 21 March 2002 the following were elected to the membership grades shown:

FELLOW

Hyde, J R

MEMBER

Beaman, R

Buckley, R R

Bull, S A

Chan, C K H

Cooper, M A

Durell, P J

Gayler, K J

Gurrie, T M

Holmes, J

Hunter, B

Jones, M

Lo, H F E

Lorenzetto, R

Madigan, K

Martin, S J

Murray, C L

Ng, W T

Ormerod, L C

Popplewell, A J

Rogers, M A

Scaife, M P

Smith, A M

Smith, R

Stephenson, S J

Tittmar, P S L

Turner, G

Vepers, A D

Wetzel, E

Witterick, S L

ASSOCIATE MEMBER

Burke, A G

Cawser, S J

Duley, U

Fox, G J

Jarvis, A P

Kopec, M

Mansley, C I

Mason, T I

Nicholls, T

O'duill, R C

Simcock, P P

Simpson, C R

Williams, T J

Woolley, M D

ASSOCIATE

North, G

O'Carroll, K L

Osborne, R L

Osborne, S E

STUDENT

Dursley, L J

Whitehead, L M

Yang, W

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Our new President

G Kerry BSc FIOA MInstP CPhys CEng

Geoff Kerry is Associate Head: Enterprise, and the Technical Manager in the School of Acoustics and Electronic Engineering at the University of Salford. He is responsible for the management of government and commercial research contracts and has overall responsibility for the School's acoustic measurement laboratory. This provides United Kingdom Accreditation Service (UKAS) accredited services on a commercial basis to industry and government departments. Geoff's main areas of interest are in the measurement and assessment of environmental and occupational noise and in building acoustics. For a number of years, he has been involved in

research into the long-range propagation of gunfire and explosive noise and into noise from military fixed and rotary wing aircraft on behalf of the Ministry of Defence. Also, research into uncertainties and measurement of environmental noise with support from DTI.

He has recently won a grant from the North West Regional Development Fund to set up an acoustic calibration laboratory and to promote the ethos of calibration traceability in the North West. He has been an active member of the BSI committee dealing with environmental noise and is the UK expert on several ISO committees concerned with impulsive noise propagation. He represents the Ministry of Defence on relevant NATO committees and is also Chairman of the UKAS Acoustic Industry Technical Advisory Committee.

Geoff is the new President of the Institute of Acoustics, having in the past been Honorary Treasurer and Vice President responsible for Groups and Branches. He has been a member of the Institute's Council for fifteen years. He has been involved in the organisation of several international conferences as well as many conferences and seminars in the UK covering topics on industrial and community noise.

He is a member of Council of the University of Salford and sits on the University's services and personnel committees, the technical and non-academic staff sub committees, and the University security committee.

Geoff Kerry is a Fellow of the Institute of Acoustics, a Member of the Institute of Physics, a Chartered Physicist and a Chartered Engineer.

Editor's Notes



Ian F Bennett BSc CEng MIOA
Editor

I have to admit to a personal interest in musical acoustics, as it is the topic which first gave me an interest in acoustics in the wider sense, and resulted in my becoming an engineer by profession. Those who ever heard me playing the flute will understand why. However, the musical-scientific connection goes much further than the design of concert halls, as a small but significant minority of the membership – the Musical Acoustics Group

– know very well. One of the feature articles in this issue investigates the use of vibrato in musical performance, and I am grateful to my Australian colleagues for permission to reproduce Neville Fletcher's interesting investigations. If nothing else, he has explained to me why wind players are better than string players at playing in tune! In this issue we continue our series about eminent acoustical pioneers with a profile of Lord Rayleigh. The idea for the series was Keith Rose's: I am responsible only for persuading authors to set fingers to keyboard. Members will be aware that Keith, the Advertising Manager for *Acoustics Bulletin*, sadly died recently. An appreciation appears elsewhere in this issue, but I wish to record here my gratitude for the help Keith gave me during my first year of occupation of this chair. He was always supportive of my efforts, never shrank from telling me when I made a mistake, and was generous with his time and experience whenever I needed them.

The last date for receipt of material for the July-August *Bulletin* should be 31 May, but since this is followed by a double bank holiday, items for publication can be accepted until 7 June.

Ian Bennett

Are YOU new blood for the Measurement and Instrumentation Group?

The Measurement and Instrumentation Group is a thriving band dedicated to keeping all members informed of all relevant issues in their area. In the past few months it has organised one-day meetings at East Midlands Airport on Long-term Noise Monitoring and at the Royal Society in London on Noise Mapping. The Group also organised the last Autumn conference at Stratford-on-Avon, jointly with the Environmental Group.

Further one-day meetings are already planned. The Committee would very much like to see other members - to widen the scope of ideas brought to the Group - whether as full or co-opted Committee members. The group meets three or four times a year to plan activities. Anyone interested in helping would be most welcome.

Please contact the Group's Chairman, Richard Tyler, AVI Ltd. on 01462 638618, or e-mail to richard@avi.f2s.com for more information or just a general chat about the workings of the Group.

Pending changes in noise and vibration legislation

Ian Watson

Very important changes are in the pipeline which will affect all those responsible for industries and processes where there is significant exposure to noise and vibration. The European Parliament (EP) was expected to vote on these new regulations last March.

It is intended to introduce limit levels for noise, hand-arm and whole-body vibration. Limit levels are defined 'as the noise or vibration exposure values above which no worker may be exposed'. This new conception could drastically curtail the maximum daily exposure time for employees who operate noisy or high vibration machinery. Costs could increase to an extent where company viability may be threatened.

These proposed changes are controversial. The Quarry Products Association has campaigned vigorously to prevent the EP from reducing the whole-body limit level from the EC's proposed value of 1.15ms^{-2} to the EP value of 0.8ms^{-2} . The proposed EP modification more than halves the allowable exposure time. The quarry industry is deeply concerned about the consequences of a 1.15ms^{-2} limit. In *Quarry Management*

magazine, it has stated with absolute clarity that the European quarry industry cannot live with a limit of 0.8ms^{-2} rms. A similar reaction is probably justified from those in agriculture, forestry, ground and road maintenance, road haulage on rough roads, operators of fork-lift trucks on rough surfaces, and many others.

The proposed hand-arm limit of 5.0ms^{-2} would create serious difficulties for many industries including foundries, metal fabrication, golf course and estate maintenance, concrete products, and local authorities. Based on recent tests, the allowable maximum daily exposure time could be less than two hours for many common power tools.

Proposed changes in noise legislation have completely changed several times in the past year. The current proposal is to allow the assumed protection of hearing defenders to be taken into account for a limit exposure value of 87dB(A). At first glance this appears to be an advantage for employers but in reality, total reliance on hearing

defenders for very high noise levels is dangerous for employers and employees alike. It sabotages the correct strategy of reducing the noise at source by a feedback to manufacturers to devote more resources to noise reduction. With these fundamentally flawed regulations employers could be easily prosecuted and sued for compensation.

General

The proposed new noise and vibration legislation would have a major impact on all industries where personnel are exposed to high noise and vibration levels, should it be ratified. Directors, managers and everyone involved in or concerned with personnel

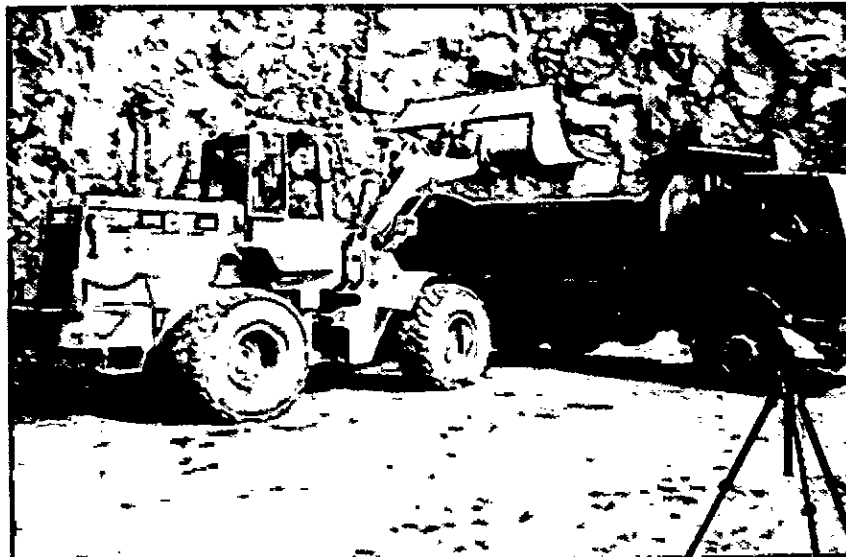
safety should study the proposals and lobby their MEP to ensure that there is the right balance for personnel protection, employer costs, company viability and long term national interests.

The responsibilities of employers for the safety of their employees are covered by general legislation - the Health and Safety at Work Act 1974, and the Health and Safety at Work Regulations 1992. This legislation makes employers responsible for the safety of their

employees. Points considered include protection against noise induced hearing loss (NIHL) and against the painful and debilitating diseases caused by excessive exposure to hand-arm and whole body vibration.

One of the important changes is the introduction of specified exposure limit levels. These are defined as the noise or vibration exposure values above which no worker may be exposed. Exposure levels are the combined effect of the noise (or vibration) and the daily exposure time. This means that a limit level determines the maximum daily allowable time for exposure to either noise or hand-arm or whole-body vibration.

Even without limit levels, legislation is already in place for employers to be held responsible for compensation claims for injuries caused by noise and vibration at work. The proposed introduction of limit levels makes it much easier for HSE to prove breach of the Regulations and prosecute the company



Controversially, the quarry industry claims it cannot live with the proposed changes, which more than halve allowable exposure time

and the responsible and accountable officers of the company. This is a double-edged sword. On the one hand it should make it safer for employees but on the other, over anxious managers may escalate costs to the detriment of employers and employees.

The Noise at Work Regulations 1989 contain detailed requirements for compliance. At present there is no detailed legislation for vibration exposure. Changes to the noise regulations and the introduction of regulations for hand-arm and whole body are near the final stages of ratification by our European Parliament. These changes will critically affect those responsible for the safety of their staff who are exposed to high noise and vibration.

If the limit levels are set too low it is obvious that costs could rise to an alarming degree. If the Regulations are strictly enforced this could affect the viability of essential companies with loss of jobs and greatly increased costs for some basic materials. If the Regulations are ignored by all but the very altruistic employers, and not stringently enforced, vulnerable employees will suffer, there will be unfair competition and a large number of compensation claims.

The best interests of both employers and employees are served by legislation which protects the vast majority of workers without threatening the viability of companies. In the end it is the consumer who pays for safety. To achieve absolute safety for everyone exposed to noise and vibration is impossible.

Consider this hypothesis. The threshold for hearing damage is a daily exposure level of 75dB(A). If legislation is ratified making the limit level 75dB(A) as from next week, and using HSE, the army, and the police to enforce this extreme legislation, there would certainly be virtually no noise induced hearing loss, but power stations and most of industry would quickly grind to a halt. The country would soon be bankrupt and in utter chaos. Mass starvation and death would soon follow.

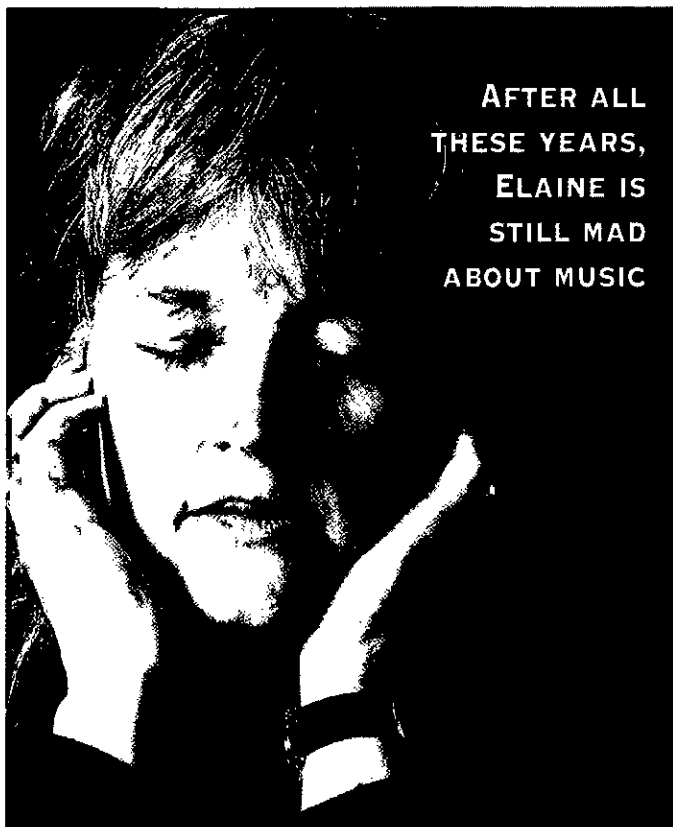
Consider the other extreme, where our Parliament ratified legislation that hearing protection could be taken into account and that the performance of hearing defenders only needed to reduce the calculated ear sound pressure level to 90dB(A). Employers with only a superficial knowledge of noise may consider this to be an attractive cost saving policy, but it is, in reality, a poisoned chalice. In the long term there would be no incentive for manufacturers to reduce workplace noise levels and there would be total reliance on hearing defenders which are notoriously unreliable. There would be widespread hearing damage and, eventually, hundreds of thousands of crippling compensation claims.

Specifying mandatory limit levels is not the best way to protect workers. It would be much better for employers, and safer for employees in the long term, to introduce a 'third action level' above which approval must be obtained from the responsible authority.

Noise

There are two general action levels and a peak action level in the current legislation which is

continued on page 20



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THESE YEARS,
ELAINE IS
STILL MAD
ABOUT MUSIC**

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Pending changes in noise and vibration legislation

continued from page 19

contained in the HSE's ninety page book *Reducing Noise at Work: Guidance on the Noise at Work Regulations 1989* (ISBN 0-7176-1511-1). The action levels are based on daily noise exposure levels which are a function of the L_{Aeq} sound pressure level and the exposure time. Since the ultimate solution of preventing hearing damage at work depends on reducing noise at source or reducing high noise exposure times, or a combination of both, hearing defenders are not taken into account in determining the action levels. This encourages a feedback to manufacturers to invest in noise reduction research and avoids total reliance on hearing defenders for exceptionally high noise levels.

The main reason why there are two general action levels is because hearing defenders have serious, inherent disadvantages such as inability to hear warnings of danger, the consequences of inadequate hygiene precautions, inconsistent acoustic performance, discomfort due to lack of ear ventilation, sweating, continuous pressure from ear muffs, and administrative difficulties in enforcing their use.

The first action level is a daily noise exposure level above 85dB(A) but below 90dB(A). Employers must warn employees that there is a risk of hearing damage, have suitable hearing protection available, and give adequate training in reducing the risk of NIHL. For this action level the risk assessment is made by the employees. They judge whether the dangers and disadvantages of hearing protectors are more important than the possibility of hearing damage. They decide whether to wear hearing protection for the first action level.

The second action level is a daily noise exposure level above 90dB(A). The employer must enforce the wearing of suitable hearing protection. This is by far the most important action level since serious hearing damage could occur if suitable and well maintained hearing protection is not worn at all times.

In April 2001 HSC issued a summary of the proposed changes to noise legislation. The main ones were to reduce the current action levels of 85 and 90dB(A) to an action level of 80dB(A) and a limit level of 85dB(A). Hearing protection must reduce the calculated ear sound level to below 80dB(A). Health surveillance under the responsibility of a medical doctor is required at an L_{Aeq} of 80dB(A) and a peak level of 135dB(C).

The main criticism to the principle behind these changes is the reduction of the second action level of 90dB(A) to a limit level of 85dB(A). This could have a devastating effect on industry. The maximum allowable time for many commonly used hand tools, machines and processes would be severely curtailed. Among the machines and processes falling into this category are angle grinders, tractors, shovels, chain

saws, metal and woodworking machinery, printing presses, paper mills, power stations, and food processing plants.

An even more serious criticism of the proposed 85dB(A) limit level is that it would force personnel to wear hearing protection in many passageways, yards, quarry roads etc, where they could be killed by not being able to hear fork-lift trucks, shovels, giant loaders, or other mobile equipment.

A much better strategy would be to keep the second action level at 90dB(A) and introduce a third action exposure level at (say) 100dB(A). Breach of the third action level would have to be reported to the responsible authority who would specify stringent conditions if there is no reasonable way to reduce the sound pressure level or exposure time.

In June 2001, Jeane Anderson, HSE, issued the following update:

- the limit level would allow hearing protection to be taken into account;
- the limit level would be increased from 85 to 87dB(A);
- hearing protectors would no longer require to reduce the risk of the calculated ear sound pressure level to below 80dB(A);
- where noise exposure varies from day to day, it can be averaged over a week rather than be based on eight hours; the requirement for health surveillance at 80dB(A) is now a right to hearing checks at 85dB(A); and
- derogation powers from wearing hearing protection have been introduced where it conflicts with other forms of health and safety.

By taking into account the assumed protection of hearing protectors, the main strategy of putting pressure on manufacturers and users to reduce noise at source is sabotaged. In the long term this could be disastrous for employees and employers.

The concession of using the assumed protection of hearing defenders could mean an increase of from 15 to 35dB in the proposed limit level of 85dB. By using high performance hearing protection there would be no control over the highest allowable L_{Ae} value. This is not acceptable because of the unreliability of hearing defenders.

In its recent book, *Reducing Noise at Work*, the HSE states that on average ear muff manufacturers overestimate the assumed protection by five decibels. The HSE also states that there could be an eighteen decibel shortfall in the assumed protection, mainly due to the poor fitting of ear plugs. In effect, the above minimum requirement of hearing defenders is to reduce the calculated L_{Ae} at the ear to 87dB(A). This is 12dB above the threshold for hearing damage and is therefore unacceptable for the safety of employees.

This erroneous strategy also exposes employers to prosecution and civil claims for compensation. Complete reliance on hearing defenders for the limit level is fundamentally flawed. It is far better for employers and for the safety of employees to rely on proper noise assessments incorporating suitable factors of safety, and sensible and logical legislation. An audiometric testing programme would be a safety net.

‘These changes could have a devastating effect on industry’

According to Jeane Anderson the next stage is for these proposals to be discussed by the European Parliament. The author strongly recommends that they should be rejected and that the April 2001 proposals, with the changes suggested in these notes, should be adopted.

Hand-arm and whole-body vibration

It is well known, and medically proven, that excessive exposure to hand-arm vibration can cause serious disorders, the most common of which is vibration white finger (vwf). This is caused by reduced blood circulation as a result of excessive hand-arm vibration exposure. Hand-arm vibration can also cause bone, joint, neurological, muscle and central nervous system disorders.

The HSE has compiled an excellent book, *Hand-arm vibration* (ISBN 0-7176-0743-7). This is essential reading for all those concerned with hand-arm vibration. Unlike noise there are no specific legal action levels at present. The HSE suggests in the book an action level of 2.8ms^{-2} rms (weighted) for hand-arm vibration exposure.

There have been thousands of research investigations by medical scientists and engineers on whole body vibration but there does not appear to be a clear agreed consensus on the relationship between whole body vibration and resulting disorders. Some medical scientists have stated that excessive exposure to whole body vibration could cause a risk to disorders of the back (pain, displacement of intervertebral discs, degeneration of spinal vertebrae, and osteoarthritis). Other disorders which have been claimed to be due to whole body vibration include digestive problems, frequent urinating, abdominal pain, prostatitis, haemorrhoids, balance and visual difficulties, headaches and sleeplessness.

The EC has singled out vibration from the Physical Agents Directive to speed up legislation. Brian Coles, HSE, gave a summary of the main EC proposals in his statement on April 2001. The current EC proposals are as follows:

- exposure action and limit levels for hand-arm vibration of 2.5 and 5.0ms^{-2} rms, respectively;
- exposure action and limit levels for whole body vibration of 0.6 and 1.15ms^{-2} rms respectively;
- transitional period of six years for 'existing equipment' before the limit levels apply;
- 'existing equipment' includes equipment provided for up to three years after date of implementation; and
- transitional period of nine years for existing agricultural equipment.

It is important to be aware that the frequency weighting curves and frequency ranges for hand-arm and whole body vibration are different. A special seat pad with a small triaxial accelerometer is required for whole body vibration. End-to-end calibration before and after each test series is strongly recommended for all vibration measurements.

A limit level of 5ms^{-2} rms for hand-arm vibration would create great difficulties for industries using hand held tools such as angle grinders, jack hammers, chain saws, hedge cutters, sand rammers, needle guns, ground and road maintenance, etc. Allowable daily exposure times could make essential companies non-viable.

Unlike noise, where hearing defenders can be used, there is no easy way to reduce the vibration level transmitted to the hands and arms. Gloves do not seem to be successful at reducing vibration levels, although they help to keep the hands warm which is very beneficial. Reducing the continuous vibration exposure time and exercising the fingers to restore blood circulation does greatly reduce the risk of hand-arm vibration syndrome (HAVS). Research to quantify this safety feature should be a high priority. It could then be taken into account in hand-arm



'there is no easy way to reduce the vibration level transmitted to the hands and arms'

vibration risk assessment.

Consideration should be given to changing the 5ms^{-2} rms limit level to a second action level at 4ms^{-2} rms requiring health surveillance under the control of a medical doctor at least once each year. A third action level could be introduced at a vibration exposure of 6ms^{-2} rms. Breach of this third action level would have to be reported to the responsible authority, which would specify stringent conditions if there was no reasonable way to reduce the hand-arm vibration amplitude and/or the vibration exposure time.

For whole body vibration there is a serious disagreement between the EC and the EP. The EC has proposed a limit acceleration of 1.15ms^{-2} rms based on the highest seat pad vibration in any of the three x, y and z planes. The EP committee has proposed reducing this limit level to 0.8ms^{-2} rms. In his progress

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Pending changes in noise and vibration legislation

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report on 2 November 2001, Brian Coles of the HSE listed the following key amendments adopted by the EP:

- to reduce the whole body vibration exposure limit level from 1.15 to 0.8 ms⁻² rms and the exposure action level from 0.6 to 0.5 ms⁻² rms;
- to reduce from six to five years the transitional period for existing equipment before the exposure limit level must apply;
- to begin the transitional period two years after adoption of the Directive, instead of three years;
- to reduce from six years to three years (from the date of adoption of the Directive) the period before the exposure limit level would have to apply to new equipment;
- to add agriculture and forestry to the list of industries eligible for derogation from the whole body vibration exposure limit levels; and
- to determine the exposure limit levels for agriculture and forestry five years after the Directive comes into force in the light of latest research and scientific information available.

Those in the quarry industry are deeply concerned about the consequences of a 1.15ms⁻² rms limit for whole body vibration. They have stated with absolute clarity that the European quarrying industry cannot live with a limit of 0.8 ms⁻² rms. A limit of 0.8 virtually

halves the allowable exposure time compared with the EC proposed limit of 1.15ms⁻² rms.


Why should the health and safety of agricultural and forestry workers be less important than others? Surely all workers should be given the same safety protection. The derogation of agriculture and forestry is an indication of the lack of reliable evidence of the relationship between disorders and whole body vibration exposure. When there is disagreement and uncertainty it makes sense to start with a relatively high limit level. Why add huge costs without reliable proof that it is necessary?

The next stage is negotiations between the Council, the EP and the Commission. If there is agreement, the Council of Ministers and the EP will formally vote for adoption of the Directive.

Final comments

The penalties for manufacturers who do not comply with noise and vibration legislation to meet the requirements for legally selling their products within the EU market is 'prosecution and penalties, on conviction, of a fine of up to £5,000 or in some cases, of imprisonment for up to three months, or of both'. Presumably the punishments for those responsible for personnel safety, for breach of noise and vibration legislation will be the same. Compensation claims could be over £100,000 per person for serious NIHL or disorders caused by excessive exposure to vibration at work.

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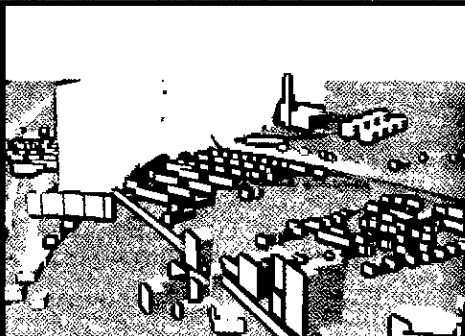


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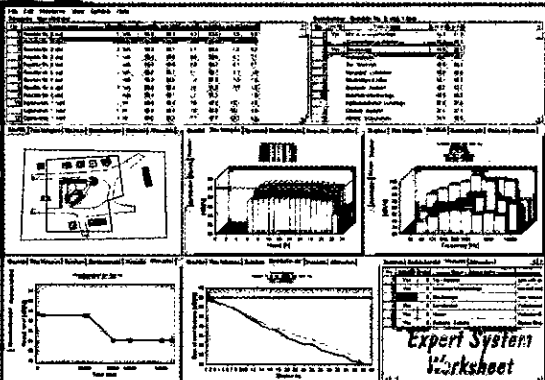
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Vibrato in music

Neville H Fletcher

Vibrato, which is an oscillation in the pitch, loudness or timbre of a musical tone, is a very important aspect of musical performance. This paper discusses the ways in which vibrato can be analysed, and also the ways in which it can be produced by performers on musical instruments and by singers

Transients have an important place in determining the subjective qualities of musical sounds. Most important are the attack and decay transients, without which most sounds lose their individuality - a recording of a piano played backwards sounds like some sort of organ - and these have received considerable attention in the literature. Within a nominally steady musical sound, however, the performer generally inserts a periodic modulation of some kind with a frequency typically around 5Hz that is called vibrato. Not all instruments or performances use vibrato, but those that do not, such as pipe organs (mostly by necessity), Renaissance viols (again by necessity), and classical orchestral clarinets (by tradition), gain individuality by this very lack.

Vibrato is, in many cases, produced by a conscious physical manipulation, such as the regular oscillation of the left hand of a violinist where it stops the string against the fingerboard. However in some situations, such as elderly singers, the vibrato seems to arise naturally through oscillation of abdominal and laryngeal muscles and to be largely uncontrolled. More skilled musicians are able to vary the amplitude, and to some extent the frequency, of the vibrato and do this for musical purpose as the notes of the melody develop.

In all cases, however, the frequency is in the range 5 to 8Hz, and it is perhaps significant that this is the typical frequency range of muscular tremors in neurological disorders such as Parkinson's disease and not too far from the resting alpha rhythm of the human brain. This suggests that both the generation and the perception of vibrato are closely related to innate human physiological and psychological characteristics. A classic discussion of psychological aspects has been given by Seashore (1).

It is not the purpose of this paper to investigate these subtle matters, but rather to examine the phenomenon of vibrato from a purely physical and mathematical viewpoint. In the course of this study a careful distinction (acoustical rather than musical) will be made between various types of

vibrato, though it is not certain that these can be clearly related to rather vague musical distinctions such as that between 'vibrato' and 'tremolo'. The term 'vibrato' will be used here to encompass all varieties of the effect.

Analysis of vibrato

While the steady sound produced by a sustained-tone instrument such as a flute, a violin, or the human voice, is strictly harmonic, the same is not true of impulsive sounds produced by instruments such as harps or guitars. In the latter, all vibrational modes have frequencies close to the nominal mode frequencies of the primary vibrating element (the string in both these cases), and these overtones are not ever in exact harmonic relationship to the fundamental (2).

In both types of instrument, however, the effect of vibrato is to impose a cyclic variation upon some important physical parameter, such as string length or blowing pressure. This results in a cyclic variation of acoustic parameters, such as the amplitudes and frequencies of the fundamental and overtones constituting the sound. The vibrato may well destroy the exact harmonicity of the overtones of sustained-tone instruments, and this is one of the possibilities to be investigated here.

Consider an infinitely prolonged note with some sort of vibrato. To the ear the sound may vary in three different ways, alone or in combination. The first is a cyclic variation in the loudness, which in music is generally called tremolo; the second is a cyclic variation in the pitch, generally called vibrato, and the third a cyclic variation in tone quality or timbre, to which a musical term has not

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Vibrato in music

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been assigned. It is helpful to examine the ways in which each of these possibilities can be measured and specified.

Time-domain analysis

This is the most straightforward but least informative way in which to describe the acoustic signal. At some specified location in the sound field the acoustic pressure $p(t)$ is measured at a sampling rate at least twice that of the highest frequency component of interest, ideally after passing the signal through a band-pass filter at that cut-off frequency in order to eliminate aliasing effects. This signal contains all the necessary information about the sound, but is of little use except for further analysis.

Fourier analysis

In Fourier analysis the signal $p(t)$ is converted into the frequency domain by performing a Fourier transform, ideally upon an infinite length of signal but in practice on a length containing an integral number of vibrato cycles. This yields a complex frequency spectrum $p(\omega)$ that also contains all the signal information. Generally this complex spectrum is converted for display to a power spectrum $P(\omega) = |p(\omega)|^2/2$ which discards the phase information.

A simple sinusoidal amplitude modulation of a signal of frequency ω and amplitude a by a vibrato frequency Ω and amplitude Δa gives rise to two side-bands at frequencies $\omega \pm \Omega$, along with the original signal at frequency ω , as shown in Figure 1(a). The relative amplitudes of the three frequency components depend upon the modulation index $\Delta a/a$, and if this becomes much greater than unity then the component at frequency ω vanishes.

A simple sinusoidal frequency modulation

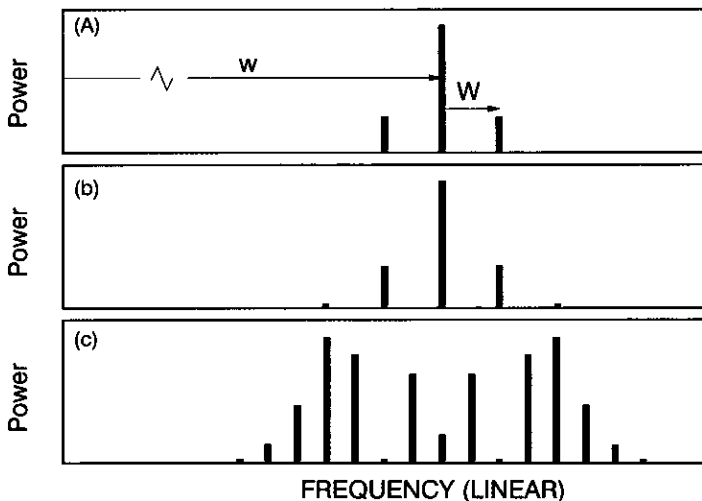


Figure 1. (a) Fourier power spectrum of an amplitude modulated signal with $\Delta a/a = 1$. (b) Power spectrum of a frequency modulated signal with $\Delta\omega/\Omega = 1$. (c) Power spectrum of a frequency modulated signal with $\Delta\omega/\Omega = 5$

by an amount $\Delta\omega$ at a frequency Ω gives rise to multiple sidebands at frequencies $\omega \pm n\Delta\omega$ with amplitudes proportional to $J_n(\Delta\omega/\Omega)$, where J_n is a Bessel function of order n . If $\Omega \ll \omega$ and $\Delta\omega \ll \omega$, as is the case in musical vibrato, then only the carrier frequency ω and the first two sidebands at $\omega \pm \Delta\omega$ are prominent, as shown in Figure 1(b), so that it may be difficult to distinguish frequency modulation from amplitude modulation simply by examining the power spectrum. At the particular modulation index for which $\Delta\omega = 2.4\Omega$ the component at frequency ω vanishes. If the vibrato is very slow, so that $\Omega \ll \Delta\omega$, then the spectrum spreads over a band of width about $2\Delta\omega$, as shown in Figure 1(c).

Fourier analysis, it should be noted, does away with the time element entirely, since it deals only with an infinitely long signal (or the same signal endlessly repeated) and yields a frequency spectrum that is time-independent. It is therefore of limited assistance in the study of musical vibrato.

Galerkin analysis

Since it is known on general grounds that the sound signal from a musical instrument is based upon a superposition of overtones $a_n(\omega_n)$ at frequencies ω_n that may or may not be in harmonic relation to the fundamental frequency ω_1 , it is often more useful to maintain this view and regard the vibrato tone as a superposition of these modes so that

$$p(t) = \sum_n a_n(t) \cos[\omega_n t + \phi_n(t)]$$

but the amplitudes a_n and phases ϕ_n are now relatively slowly varying functions of time. The apparent frequency of mode n is then

$$\omega_n' = \omega_n + d\phi_n/dt$$

This modal decomposition of the signal, known as the Galerkin approximation, has the great advantage that it yields an 'instantaneous amplitude' and 'instantaneous frequency' that both correspond closely with psychophysical perception, though the terms themselves are not analytically respectable. It is possible to use this approximation to calculate the behaviour of many nonlinear systems of the kind found in musical instruments (3). The approach gives a readily interpreted picture of the amplitude and frequency of all components of the sound without the complication of sidebands.

One possible problem with this approach is that, if the phase ϕ_n jumps suddenly, then this appears as an infinity in the frequency. An example of this is the case of amplitude modulation or beating with $\Delta a \gg a$. Here the signal has the form $a \sin \omega t \cos \Omega t$ and, if the amplitude a is taken as always positive, then there is a phase jump of π twice in each period, with consequent frequency infinities.

Fast Fourier transform analysis

While a fast Fourier transform (FFT) is simply a rapid and convenient numerical algorithm for performing a Fourier transform, it differs practically in that this transform is generally performed repetitively on successive small sections of signal and displayed as a time-resolved power spectrum. The frequency resolution $\Delta\omega$ is related to the length Δt of the transformed sample by the condition $\Delta\omega \Delta t \approx 2\pi$, while the Nyquist cut-off frequency is

$\omega^* = \pi N / \Delta t$ where N is the number of data points in the transform. Since N is normally fixed by the software used for the computation, the result is a simple trade-off between frequency resolution and time resolution.

If time resolution is sacrificed in favour of frequency resolution so that the sample length is greater than twice the vibrato period, then the FFT approach behaves like the normal Fourier transform and shows a 'carrier frequency' and two sidebands for each mode. If, on the other hand, time resolution is made significantly less than the vibrato period, the FFT will display a set of modes that vary cyclically in frequency and amplitude, following the Galerkin approximation. Because the FFT approach effectively averages the Galerkin approximation over the sample time, if this is short, the possible infinities in frequency are reduced to simply large jumps, but these jumps need to be carefully interpreted.

Sonograph analysis

The most useful analysis tool derives from the Sonograph, which in its early forms rotated a sensitive paper on a drum bearing the recorded track to be analysed. The rotation slowly swept an analysing filter through a frequency range from zero to about 5 kHz, and the stylus imprinted the signal level on the paper, giving a time-resolved spectrum of selected bandwidth. Modern signal analysis programs perform the same operation digitally. The figures in the present paper are derived from one such program (4).

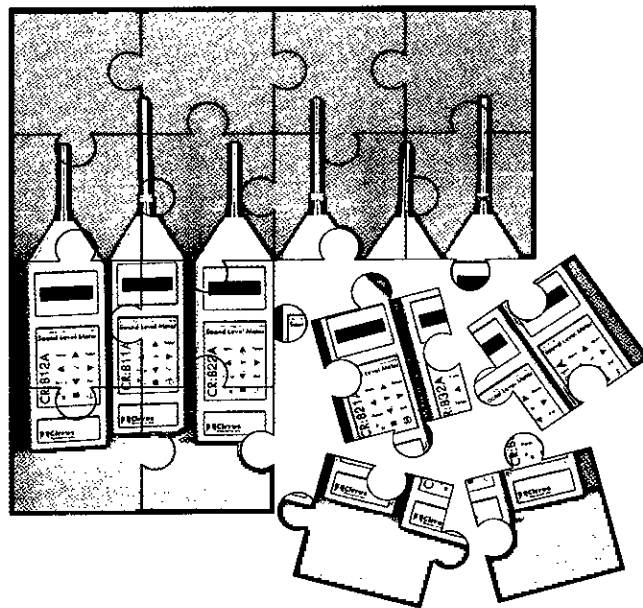
Human auditory perception

Since the object of this analysis is to relate perceived vibrato effects to physical parameters of the performance, it is important that a method of analysis is chosen which adequately approximates human auditory perception. Numerous psychophysical studies (5) show that human auditory resolution is rather less fine than 50ms and that, while a frequency resolution of about 3 cents, or about 0.2%, is possible near the mid-range of the frequency spectrum, such resolution requires sounds that are steady for several seconds. (One semitone is a change in frequency by a factor $2^{1/12}$ or about 6% and is divided logarithmically into 100 cents). When the tone duration is 1s or less, the frequency resolution declines rapidly. Similarly, changes in sound level of 1dB are perceptible when they occur at intervals of a second or more, but become progressively less obvious when they occur more rapidly.

These considerations suggest that a method of analysis with a time resolution of about 100ms and a corresponding frequency resolution of about 10Hz, which corresponds to about 2% or 30 cents near the middle of the treble stave (about 400Hz), is probably about optimal for analysing vibrato. An FFT analyser with 1024 data points adjusted to meet these criteria will have an upper cut-off frequency of about 5kHz, which is adequate for the analysis of most musical sounds, though of course the audible components of these sounds extend to much higher frequencies.

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Vibrato in music

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Varieties of vibrato

The most musically and acoustically revealing method of analysis of musical vibrato is an appropriate form of FFT analysis, with the sample length of about 100ms, so that the frequency resolution is about 10Hz, as discussed above. Applied to a typical musical vibrato, this analysis generally indicates a combination of frequency and amplitude modulation of the sound, which is indeed what the listener hears, though it is possible to concentrate perceptive attention on one or other characteristic. A musical note, however, is not generally a simple sinusoid with a single frequency, but rather consists of a fundamental accompanied by an array of overtones. The effect of vibrato may

this effect, so it is not real vibrato.

In a guitar, however, the player uses one finger to 'stop' the string he is plucking, and this finger has a position between two of the frets on the neck of the instrument so that the vibrating length is determined by the lower fret position. If, however, the player rocks this finger backwards and forwards, then this has an effect on the tension in the string because of slight variation in the displaced length between the frets. This tension variation in turn varies the vibration frequency of all of the string modes by exactly the same fractional amount, giving a coordinated frequency modulation to the string motion.

The matter is, however, not as simple as this. The string vibration must be communicated to the instrument body for sound radiation, since the string itself radiates almost no sound because its diameter is so small compared with the sound wavelength involved. The guitar body, however, has many resonances - indeed it is the distribution of these resonances that distinguishes a fine guitar from a poor one. As the frequency of any mode varies under the effect of changing tension, therefore, this alters a little the response of the instrument body as the frequency moves closer to or away from the nearest resonance.

There is also an associated change of phase, which adds to the initial frequency modulation. The result is that the simple frequency modulation of the string acquires an amplitude modulation as it is transferred to the body and radiated. When this sound signal is analysed by the FFT method, those parts of the signal with higher amplitude are given higher weight, with the result that there may appear to be a slight shift in the median vibration frequencies of individual modes in addition to the vibrato.

Bowed strings

In a bowed string instrument such as the violin, the string vibration is maintained by a stick-slip frictional phenomenon between the moving bow and the string - hence the importance of rosin to enhance the friction. This stick-slip motion is highly nonlinear, with the result that the vibrational motion of the string repeats regularly, giving a precisely harmonic sound for sustained notes. Vibrato is again introduced by rocking the active finger tip against the fingerboard, as in the guitar. However, because there are no frets, the result is not a change in tension but rather a change in string vibrating length.

Analysis of this situation is very difficult, because it constitutes a 'moving boundary problem'. Yet, because the vibrato frequency is very much lower than the fundamental string vibration frequency (5Hz compared with 200-2000Hz), it is a reasonable approximation to perform a calculation using a quasi-static approximation. The string frequency is then seen to vary approximately sinusoidally at the finger-motion frequency. The fact that the violin body is intimately involved in sound radiation, and that it possesses pronounced resonances of its own, affects the vibrato in the same way as for the guitar, making the final effect one combining frequency, amplitude, and timbre variations. The maximum

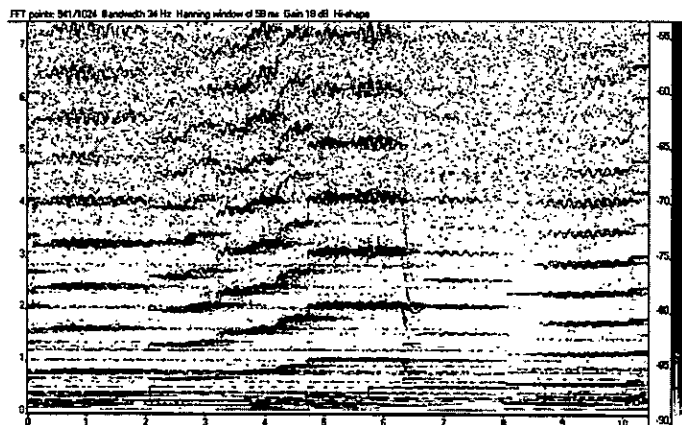


Figure 2. Soundswell analysis of Nigel Kennedy (violin) playing an excerpt from the Meditation from Massenet's Thais. The time span is about 10 seconds and the frequency range 0-7 kHz. Maximum vibrato amplitude is $\pm 3\%$ or about half a semitone.

differ from one overtone to another, so that a third form of vibrato can be identified that might be termed 'timbre' vibrato, where the musical word 'timbre' refers to tone colour.

Impulsive stringed instruments

A piano has an inherent amplitude-modulation, though not really a vibrato, for each overtone of the sound by virtue of the fact that most notes are sounded by several strings vibrating in unison. The interaction between the strings is complicated (6) and arises because the bridge is necessarily not completely rigid, since it must transmit the string vibrations to the soundboard. The player, however, has no control over this effect, so it will not be considered further here, despite the fact that it is important to the quality of piano sound.

Something similar happens in the harpsichord and the harp but has a different origin because these instruments have only one string per note (although large harpsichords may have additional strings at octave or sub-octave pitches). Since the string is not generally plucked exactly at right angles to the bridge, it has a tendency to oscillate in an elliptical path; this ellipse precesses slowly and gives an amplitude modulation to the normal force on the soundboard. Again the player has no control over

frequency variation in vibrato is typically about 3% or about 50 cents, as shown in *Figure 2*.

Since the violin is a sustained-tone instrument, vibrato is an important feature of its sound quality, and is almost always used. This contrasts with Renaissance bowed-string instruments of the viol family, which have cords tied around the fingerboard

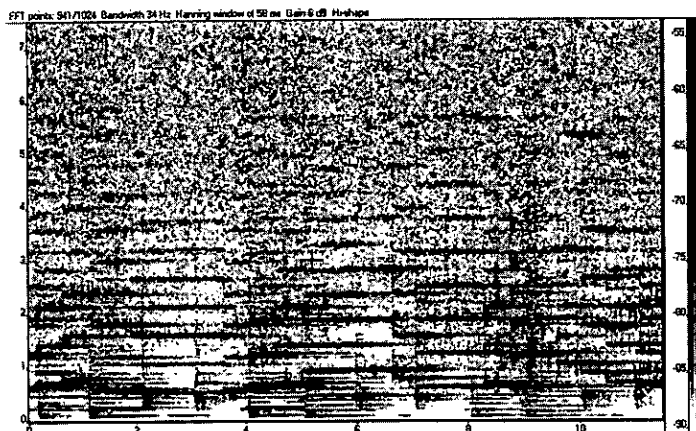


Figure 3. William Bennett (flute) playing part of the Largo from Bach's Concerto for Flute and Strings BWV1056. Maximum vibrato amplitude is 1.5% or about one-quarter of a semitone. The apparent overlap of notes is due to reverberation.

to constitute very shallow frets, and are played without any vibrato at all. Adjustment of the frets allows notes to be played easily in tune, a feat which is much more difficult on the violin and which accounts, in part, for the popularity of vibrato.

Violins and other bowed-string instruments are often heard in groups, as in an orchestra, and here the vibrato takes on another role. The string players make no attempt to coordinate their individual vibratos, so that the result is a sound consisting of many superimposed signals with slightly differing frequencies and vibrato rates. When this is considered on the basis of Fourier analysis, the signal is seen to be rather like narrow-band noise. This is called a 'chorus effect' and is particularly pleasant to most listeners.

Flute-like instruments

In instruments of the flute family, a tube resonator with finger holes to adjust its acoustic length is excited by an air jet from the player's lips which blows alternately into and out of the instrument mouth-hole. The air jet itself is very complex, and its motion involves the propagation of displacement waves excited upon it by acoustic flow out of the mouth-hole. The interaction of the jet with the sound modes in the tube at the upper lip of the mouth-hole is similarly complex. To sound a given note, the player must control the air-jet length and blowing pressure within fairly narrow limits, or the instrument will either not sound or will sound a higher mode than the one intended.

Vibrato in flute instruments is generally produced by a cyclic variation of about 10% in the blowing pressure. The relative levels of the upper harmonics of the sound depend quite sensitively upon the blowing pressure, while the amplitude and frequency of the fundamental varies by only a very small amount. The result is a vibrato that has been characterised as being a 'timbre vibrato' since there

was relatively little change found in either pitch or radiated sound power (7). Timbre variations do, however, have an effect upon perceived loudness.

A more recent study using FFT techniques (8) has, however, shown periodic variations of about ± 30 cents in the frequency of the fundamental and rather large and erratic variations in the apparent frequencies of the higher modes, these variations increasing in extent with the mode number. As discussed above, it is possible that these frequency variations are produced by changes in phase, due perhaps to associated variations in the exact blowing angle of the jet in relation to the edge of the mouthpiece (9). Such phase changes increase in magnitude in proportion to the mode number.

However, the FFT analysis reported in this paper raises some questions about the reality of the frequency fluctuations, since the displayed time resolution is about 0.01s and the frequency resolution better than 10Hz rather than the expected 100Hz. The analysis shown in *Figure 3* shows a maximum vibrato shift of about 25 cents, which confirms the figure given in the referenced publication, but no anomalies are evident in the higher harmonics of the sound.

In the flute, as in other wind instruments that use vibrato, the rate and extent of this vibrato is under the player's control. Often a sustained note

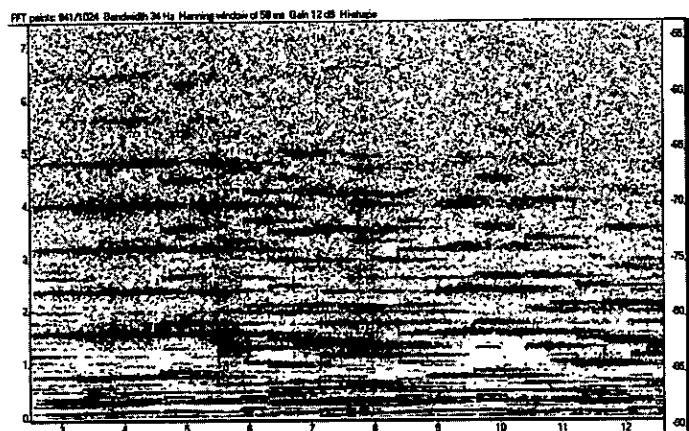


Figure 4. The oboist of the Stuttgart Chamber Orchestra playing the introduction to the Echo Duet of Bach's Christmas Oratorio. Maximum vibrato amplitude is $\pm 2.5\%$ or about 0.4 semitones.

at the beginning of a phrase will start with almost no vibrato, but this will build up in frequency and amplitude during the course of the note and lead on to the next note in the phrase. Conversely, near the end of a phrase this sequence may be reversed. The normal frequency of vibrato, generally in the range 5 to 6Hz, is also often characteristic of the individual player.

Other wind instruments

Reed wind instruments, such as oboes or clarinets, can also produce vibrato, either by oscillation in blowing pressure or, less commonly, by lip pressure on the reed. The vibrato is under the control of the player to the extent that bassoons, for example, may use vibrato when playing duets with oboes but not when playing with clarinets, simply because

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Vibrato in music

continued from page 27

it is traditional for orchestral clarinets to play without vibrato. There does not appear to have been any detailed acoustic study of this vibrato, but the analysis given in *Figure 4* suggests that the frequency variation is only about ± 40 cents and that variations in loudness and timbre may also be important.

Brass instruments do not generally use vibrato to any great extent, perhaps partly because of the physical requirements on blowing pressure and lip tension necessary to produce the desired sound and partly because of tradition, which has established that these instruments sound better when played 'straight'.

The singing voice

Vibrato in singing has received a good deal of attention from teachers but less from acousticians. Typically the singing voices of children make no use of vibrato, and this creates the 'pure' or 'simple' sound characteristic of English cathedral choirs. The voices of girls continue to develop smoothly as their age increases, and it is usual for a small amount of vibrato to develop.

After the age of 20 or so, the extent of vibrato depends upon artistic choice and physical development. Some professional female singers maintain a voice with very little vibrato for many years, and this style goes very well with the music of composers such as Purcell and with much folk music. Other singers follow a more operatic tradition and use pronounced, and even exaggerated, vibrato in all their singing. After many years of singing in this style, it seems impossible for the singers to revert to simple sounds, and the vibrato intensity generally continues to increase as they age. While this is perhaps appropriate in some music with dramatic emotional content, it is seen by many as an unfortunate defect in singing style.

Male singers do not seem to develop vibrato to the same extent, or else perhaps it is made less obvious by the lower voice pitch. Certainly a few well-known bass singers have developed with age a style with a large and rapid vibrato to the extent that the pitch of the note being sung is largely obscured.

While the physiological mechanisms of vibrato generation in singing have been the subject of detailed study (10), results vary somewhat from one singer to another. The pitch of a vocal tone is determined almost entirely by tension in the muscles supporting the vocal folds, though this tension is itself influenced to some extent by sub-glottal pressure. The primary origin of vibrato thus lies with the muscles controlling the larynx, though there is evidence of coordinated oscillation in muscle tension in the chest and abdomen, leading to synchronised oscillations in sub-glottal pressure. Because the fundamental frequency of the human voice is not locked to any resonance of the vocal tract, the singer has a great deal of freedom in pitch

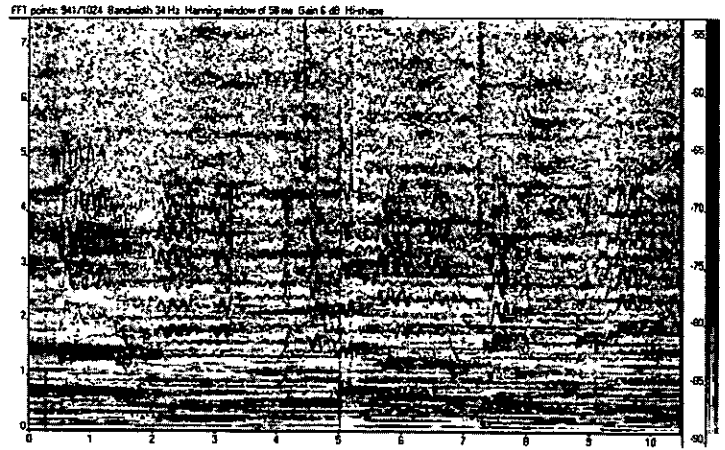


Figure 5. Sound spectrogram of Dame Joan Sutherland singing a tranquil section of Puccini's *Suor Angelica*. The time span is 10 seconds and the frequency range 0 to 7 kHz. Maximum vibrato amplitude is $\pm 10\%$ or about 1.7 semitones.

variation during vibrato.

Quantitative studies of vocal vibrato have been made by several people, and are discussed by Sundberg (10), while a more recent analysis of prominent artists singing Schubert's *Ave Maria* has been reported by Prame (11). For the quiet mood of the Schubert song, the vibrato rate was 6.0 ± 0.4 Hz and the average vibrato extent 71 ± 9 cents, though this varied from 34 to 123 cents for different notes and different singers.

In the wider and more operatic repertoire (10) some well-known sopranos actually use vibrato as large in extent as ± 2 semitones! (If the vibrato is larger in extent than this it is called 'trillo'). For such a large vibrato, the perception is of an actual fluctuating pitch, rather than a variation of tone quality on a particular note. For smaller vibratos, however, the pitch perceived by a listener is very close to the average frequency of the sound, so that a wide vibrato does not allow the singer to be far out of tune without this being evident.

Figure 5 shows a typical example of vocal vibrato for a distinguished soprano singing a quiet meditative piece of music. Even here the frequency variation is about ± 170 cents, or nearly two semitones in either direction, but the listener senses the average pitch with quite high accuracy.

Despite what appears to be the almost autonomous nature of the muscle vibrations responsible for vibrato in singing, the performers do have some measure of control over its amplitude and frequency. The vibrato intensity generally increases with loudness and emotional content of the music, though whether this is conscious or subconscious is not clear. Another level of control is shown in a study of duet singing by pairs of distinguished sopranos, as recently reported by Duncan et al (12). They found that, in some cases, the singers adjusted their singing so that their vibratos were approximately synchronised, sometimes in-phase and sometimes anti-phase.

When, as often happens, mature singers combine to form a choir, their individual vibratos are not synchronised so that, as for groups of violins, the result is analogous to a narrow-band noise signal.

This 'chorus effect' is by no means unpleasant, and indeed adds characteristic beauty to such combined singing. The resulting auditory effect is in sharp contrast to the nearly 'pure-tone' effect produced by groups of boy sopranos in cathedral choirs, where vibrato is not generally used.

Conclusions

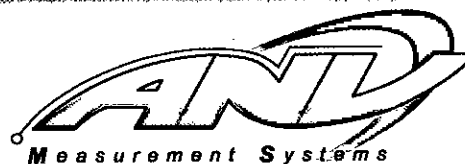
Vibrato is an important component of many musical sounds and allows the performer to impose subtle variations upon the quality of notes. It has become so nearly universal, however, that some performances, particularly of early music, gain distinction from the absence of vibrato! In the best performances, the nature and extent of the vibrato are under the close control of the musician and are varied to suit the demands of the item being performed, and indeed help to shape the style of individual phrases within that performance. Unfortunately, many singers appear to develop an uncontrolled and excessive vibrato with increasing age, which detracts from the beauty of their songs.

This brief survey has shown that only some aspects of musical vibrato are understood in detail. There is ample scope for a comprehensive and comparative study, and a proper understanding of vibrato can add life to the otherwise mechanical sounds of electronic and computer-generated music.

REFERENCES

1. C E Seashore, *Psychology of Music*, McGraw-Hill, New York 1938, reprinted by Dover, New York 1967, Ch 4.
2. N H Fletcher, 'The nonlinear physics of musical instruments', *Rep Prog Phys* **62**, 723-764 (1999).
3. N H Fletcher and T D Rossing, *The Physics of Musical Instruments*, (second edition) Springer-Verlag, New York 1998, Ch 5.
4. Hitech Development (Sweden), *Soundswell* (www.hitech.se)
5. E Zwicker and H Fastl, *Psycho-Acoustics: Facts and Models*, (second edition) Springer-Verlag, Heidelberg 1999, Ch 7.
6. G Weinreich, 'Coupled piano strings', *J Acoust Soc Am* **62**, 1474-1484 (1977).
7. N H Fletcher, 'Acoustical correlates of flute performance technique', *J Acoust Soc Am* **57**, 233-237 (1975).
8. A Nishimura, M Kato and Y Ando, 'The relationship between the fluctuations of harmonics and the subjective quality of flute tone', *Acoust Sci & Tech* **22**, 227-238 (2001).
9. N H Fletcher and L M Douglas, 'Harmonic generation in organ pipes, recorders and flutes', *J Acoust Soc Am* **68**, 767-771 (1980).
10. J Sundberg, *The Science of the Singing Voice*, Northern Illinois University Press 1987, pp 163-176.
11. E Prame, 'Vibrato extent and intonation in professional Western lyric singing', *J Acoust Soc Am* **102**, 616-621 (1997).
12. M Duncan, C Williams and G Troup, 'Vibrato frequency and phase lock in operatic duet quality', *Acoust Aust* **27**, 5-9 (2000).

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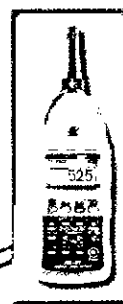


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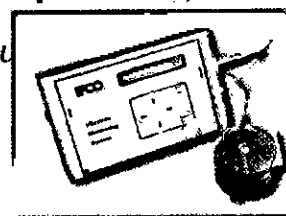
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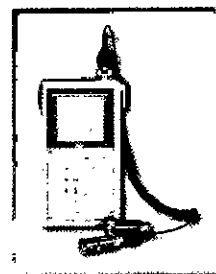
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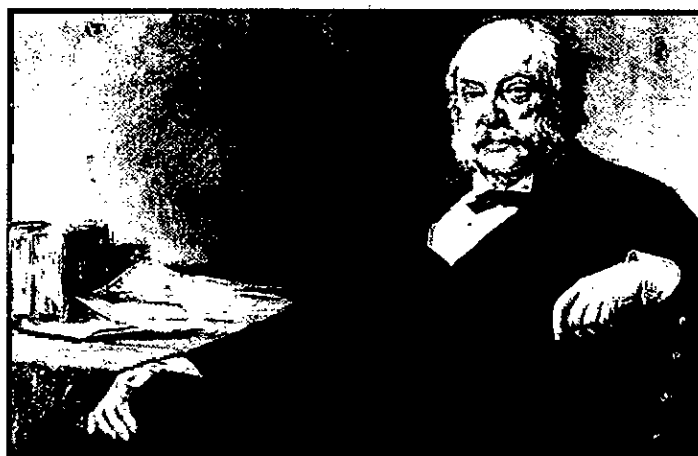
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Lord Rayleigh

1842-1919



Lord Rayleigh at his desk

This article refers to John William Strutt as Rayleigh throughout, although he did not succeed to the title until he was 30 years old. He was one of the very few members of higher nobility to win fame as an outstanding scientist. His father was the second Baron Rayleigh of Terling Place, Witham in the county of Essex. It was a family that had little connection with science for its members were mostly landowners with extensive holdings and interests in the countryside. One exception was Robert Boyle - a distant relation.

The Rayleigh title was originally given to his grandmother, Charlotte, on her husband's suggestion. Joseph Holden Strutt had declined personal honours throughout his life, and probably did not wish to be raised to the peerage as he would then have been obliged to resign his seat in the House of Commons. The title had been offered by George III in recognition of Joseph's duties in the army and in Parliament. On Charlotte's death in 1836, the title passed to their only son John James Strutt, who became the second Baron Rayleigh.

John James Strutt, a deeply religious man, led the life of a country squire in Essex, north-east of London. Aged 46, he married Clara Elizabeth LaTouche Vicars, who was only 17 at the time. John William, their eldest son, was born on 12 November 1842 at Langford Grove, near Maldon, Essex.

Throughout his infancy and youth 'our' Rayleigh was of frail physique. His education was repeatedly interrupted by ill-health, and his prospects of attaining maturity appeared precarious. After a short spell at Eton at the age of 10, mainly spent in the school sanatorium, three years in a private school at Wimbledon, and another short stay at Harrow, he finally spent four years (1857 to 1861) with the Rev George Townsend Warner who took pupils at Torquay. At this stage he did begin to show signs of mathematical aptitude but overall there was little indication that he was anything other than an average child of average ability.

He entered Trinity College, Cambridge in October 1861 where he took the mathematical Tripos. Here his coach was Edward Routh who, in addition to being the most famous of the Cambridge coaches at that time, was himself a very fine applied mathematician making important contributions to dynamics. There is no doubt that the grounding in mathematical techniques which Rayleigh received from Routh was an important factor in his outstanding scientific career. It was more than just

the mathematics which he learnt that was important to him, for in addition he learnt how to come up with the most appropriate mathematical methods to tackle each problem.

There was another important influence on Rayleigh during his undergraduate years at Cambridge, namely Stokes, who was the Lucasian professor of mathematics at the time. Stokes inspired Rayleigh with his lectures which combined theory and practice in a novel way with many physical experiments being carried out during the lectures.

Students did not have the opportunity to undertake physics experiments themselves, so seeing Stokes perform experiments in his course on light was Rayleigh's only exposure to the experimental side of science. Rayleigh himself later spoke of how important a role Stokes had played in his development as a scientist. However Stokes does not appear to have directly encouraged Rayleigh to undertake a scientific career.

If Rayleigh had been an average school pupil he was far from an average student. He was awarded an astronomy scholarship in 1864, then in the Tripos examinations of 1865 he was Senior Wrangler (the top First Class student) and in the same year was the first winner of the Smith's Prize. He was now faced with a difficult decision. For someone in his position, knowing that he would succeed to a title and become the third Baron Rayleigh, taking up a scientific career was not really acceptable, and some members of his family felt exactly that way. By this time, however, Rayleigh was determined to devote his life to science so he was certain in his own mind that his social obligations must not stand in his way.

His first paper was inspired by reading Maxwell's 1865 paper on electromagnetic theory. It was through reading widely the current scientific literature that Rayleigh tried to work out those important problems on which he should undertake research. The other scientist whose works he studied deeply was Helmholtz, particularly in reading the 1860 results on the acoustic resonator. In 1866 Rayleigh was elected a Fellow of Trinity College, Cambridge and was now poised to make his mark in science.

The usual course of action for young men of social standing at this time was to take a European tour - the Grand Tour, as it was called. Rayleigh, surprisingly, took a very different and unusual course, for he set out on a trip to the United States of

America, where he met President Andrew Johnson. One advantage of Rayleigh's privileged social position was that he did not need an academic post to earn his living. Instead, when he returned from the United States he bought equipment for undertaking scientific experiments and set it up on the family estate at Terling. He did experiments on the galvanometer and presented his results to the British Association meeting in Norwich in 1868.

Rayleigh's theory of scattering, published in 1871, was the first correct explanation of why the sky is blue. In the same year he married Evelyn Balfour, the sister of Arthur James Balfour who was to be a leading member of the Conservative Party for 50 years and Prime Minister 30 years later. Rayleigh had been a student at Cambridge with Arthur James Balfour and through him had met Evelyn. They were destined to have three sons, the eldest of whom was to become Professor of Physics at Imperial College of Science and Technology.

Shortly after their marriage Rayleigh had an attack of rheumatic fever which nearly brought his scientific activities to a premature end. He was advised to travel to Egypt and Greece, and set off with his wife. They sailed down the Nile during the last months of 1872 and early 1873, returning to England in the spring of that year.

It was a trip during which Rayleigh recovered his health but it was also very profitable from a scientific viewpoint. Remarkably he began writing a major text, *The Theory of Sound*, while on the trip. Five years were to elapse before this great classic appeared in print. The first volume, on the mechanics of a vibrating medium which produces sound, was published in 1877, while the second volume, on acoustic wave propagation, was published the following year.

Shortly after his return from the Nile, Rayleigh's father died and John William succeeded to the title, becoming the third Baron Rayleigh. He continued working at Terling where he now took up residence. He now found himself compelled to devote part of his time to managing his estates (7000 acres). The combination of general scientific knowledge and acumen with acquired knowledge of agriculture made his practice in estate management in many respects in advance of his time. Nevertheless, in 1876 he left the entire management of the land to his younger brother.

Although the laboratory which he set up at Terling was one where he made impressive discoveries, it would be a mistake to think this was because the 'rich' Rayleigh was able to have better equipment than anyone else. On the contrary he obtained impressive experimental results with cheap equipment: he was always one to economise and make do with unsophisticated equipment. In fact,

he was not as well off as might have been expected, for the 1870s saw a period of economic problems for English farming. Consequently his income was far lower than might otherwise have been the case.

He left experimental notebooks as the record of many years' work in his laboratory, and these indicate his deep interest in the phenomenon of resonance. Rayleigh's interest in acoustics and vibration may have followed on from optics, and the work in optics had been done 'perhaps more *con amore* than any other'. Rayleigh's papers go straight to the heart of the problems under investigation, using the minimum of mathematics for the solution.

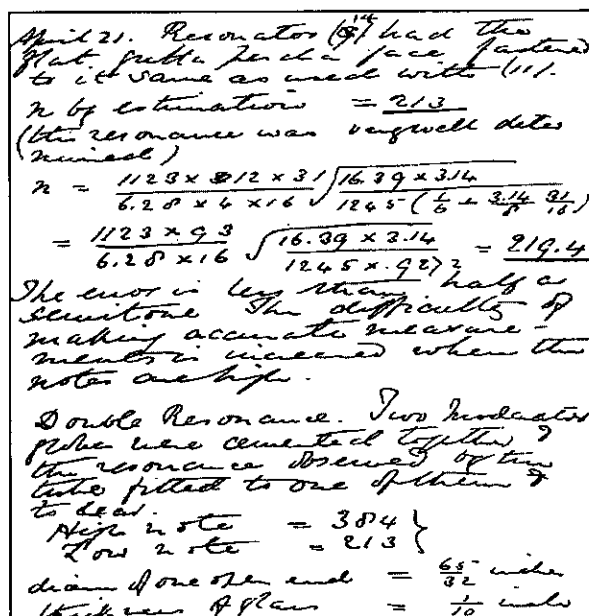
From 1879 to 1884 Rayleigh was the second Cavendish professor of experimental physics at Cambridge. The laboratory had been opened in 1874 and Maxwell had been the first Cavendish professor. On the academic side Rayleigh was an obvious choice to succeed to Maxwell's chair, yet in other times he might have been content to work at Terling.

The agricultural depression swung the balance, making the income from the post look attractive. There was no suggestion, however, that Rayleigh was just there for the money. On the contrary, he took his duties very seriously making very substantial improvements to the teaching of physics at Cambridge. The task of organising the laboratory as a centre of instruction and research fell to him, and he accomplished it with outstanding success.

There was a distinct lack of experimental physics when Rayleigh himself was an undergraduate and although changes were being made, a great deal still needed to be done.

With the same energy with which he approached everything, Rayleigh developed laboratory courses in heat, electricity and magnetism, properties of matter, optics, and acoustics. He was an excellent instructor and, under his active supervision, a system of practical instruction in experimental physics was devised at Cambridge, developing from a class of five or six students to an advanced school of some seventy experimental physicists.

One of the important pieces of experimental work he carried during his time as Cavendish professor was a standardisation of the ohm. Maxwell and Chrystal had carried out experiments in Cambridge earlier and the apparatus was still available for Rayleigh. However the old equipment did not prove good enough to allow him to obtain the accuracy he required and he had new apparatus built. In his Presidential Address to the British Association in Montreal in 1884 Rayleigh explained the results. He introduced the topic by saying:



A page from one of Rayleigh's notebooks

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Lord Rayleigh

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‘During the last few years much interest has been felt in the reduction to an absolute standard of measurements of electromotive force, current, resistance, etc. and to this end many laborious investigations have been undertaken. The subject is one which has engaged a good deal of my own attention.’

In 1884 he resigned his chair at Cambridge to return to his research on his own estate at Terling. His financial position had improved and what he loved was scientific research, without the time-consuming responsibilities of a university post. There were many colleagues who tried to get him to reconsider his action and continue to hold the chair but Rayleigh knew exactly what he wanted from life. It was not a solitary scientific existence for him in Terling, since he made frequent visits to London where he had duties to perform for many learned and scientific societies.

Rayleigh had been elected as a Fellow of the Royal Society in 1873. He received the *Royal Medal* from the Society in 1882, and became secretary of the Society in 1885, being awarded the *Copley Medal* in 1899. He gave the Bakerian Lecture in 1902 and he was elected President of the Society in 1905, holding the position until 1908.

Rayleigh served as President of the London Mathematical Society from 1876 to 1878 and he was

awarded the Society's de Morgan Medal in 1890. He also had connections with the Royal Institution, becoming professor of natural philosophy there in 1887, a successor of Tyndall. He received the Order of Merit in 1902 and became Chancellor of Cambridge University in 1908.

Other activities which deserve mention involve the work he put in towards helping establishing the National Physical Laboratory which was set up at Teddington in Middlesex in 1900. He served for six years as President of a Government Committee on Explosives and from 1896 to 1919 he was Scientific Advisor to Trinity House. He was Lord Lieutenant of Essex from 1892 to 1901. Connected with the political scene through his wife, he was much involved in advisory roles such as serving on a committee on aeronautics. In 1905 he was made a Privy Councillor.

These activities still allowed him to discuss and correspond with many leading scientists. His first researches were mainly mathematical, concerning optics and vibrating systems, but his later work ranged over almost the whole field of physics, covering sound, wave theory, colour vision, electrostatics, electromagnetism, light scattering, flow of liquids, hydrodynamics, density of gases, viscosity, capillarity, elasticity, and photography. His patient and delicate experiments led to the establishment of the standards of resistance, current, and electromotive force; and his later work was concentrated on electric and magnetic problems.

Apart from his *Theory of Sound*, other extensive studies are reported in his Scientific Papers - six volumes issued during the period 1889 to 1920. He also contributed to the *Encyclopaedia Britannica*.

He had a fine sense of literary style. Every paper he wrote, even on the most abstruse subject, is a model of clearness and simplicity of diction. The 446 papers reprinted in his collected works clearly show his capacity for understanding everything just a little more deeply than anyone else. Although a member of the House of Lords, he intervened in debate only on rare occasions, never allowing politics to interfere with science. His recreations were travel, tennis, photography and music.

Among the publications devoted to mathematics, rather than its applications, are papers on Bessel functions, the relationship between Laplace functions and Bessel functions, and Legendre functions. In addition to the more usual topics of applied mathematics and physics, he wrote on more unusual topics such as *Insects and the colour of flowers* (1874), *On the irregular flight of a tennis ball* (1877), *The soaring of birds* (1883), *The sailing flight of the albatross* (1889), and *The problem of the Whispering Gallery* (1910).

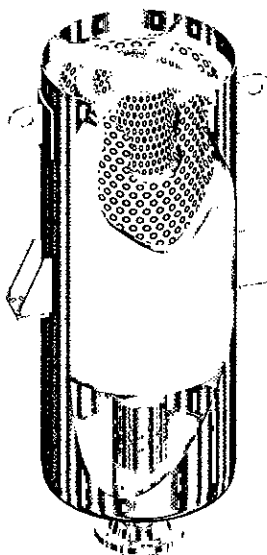
His work on electromagnetic phenomena, his major treatise on sound, the determination of the ohm, and his important paper on scattering of light - which explained why the sky is blue - are probably the best known. In addition, he applied the wave theory of light to the mathematical investigation of the resolving power of prisms and diffraction gratings. He showed that the resolving power of a grating is determined by the total number of lines in the grating multiplied by the order of the spectrum, and not by the closeness of the lines. In 1887 he published a paper in which he suggested the method

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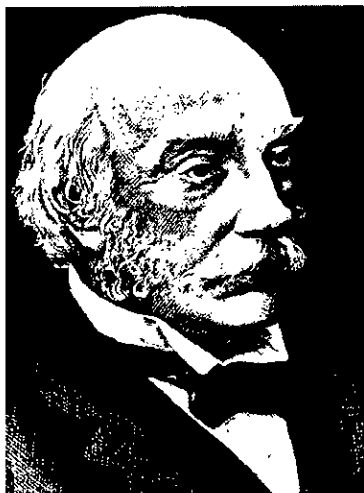
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of reproducing colours by photography later adopted in principle by Lippmann.

Rayleigh is famous for his discovery of the inert gas argon in 1895, work which earned him a Nobel Prize in 1904. In his address on the occasion of receiving the Nobel Prize Rayleigh explained how he made his famous discovery:

‘The subject of the densities of gases has engaged a large part of my attention for over 20 years Turning my attention to nitrogen, I made a series of determinations Air bubbled through liquid ammonia is passed through a tube containing copper at a red heat where the oxygen of the air is consumed by the hydrogen of the ammonia, the excess of the ammonia being subsequently removed with sulphuric acid Having obtained a series of concordant observations on gas thus prepared I was at first disposed to consider the work on nitrogen as finished Afterwards, however, I fell back upon the more orthodox procedure according to which, ammonia being dispensed with, air passes directly over red hot copper. Again a good agreement with itself resulted, but to my surprise and disgust the densities of the two methods differed by a thousandth part - a difference small in itself but entirely beyond experimental errors It is a good rule in experimental work to seek to magnify a discrepancy when it first appears rather than to follow the natural instinct to trying to get quit of it. What was the difference between the two kinds of nitrogen? The one was wholly derived from air; the other partially, to the extent of about one-fifth part, from ammonia. The most promising course for magnifying the discrepancy appeared to be the substitution of oxygen for air in the ammonia method so that all the nitrogen should in that case be derived from ammonia. Success was at once attained, the nitrogen from the ammonia being now 1/200 part lighter than that from air Among the explanations which suggested themselves are the presence of a gas heavier than nitrogen in air’

Rayleigh of course was correct and succeeded, with considerable difficulty, in isolating the gas. Since



Rayleigh in later life

it refused to make chemical combinations it was called argon from the Greek word for inactive.

In 1879 Rayleigh wrote a paper on travelling waves, this theory has now developed into the theory of solitons. Rayleigh-wave theory, introduced by him in 1885 in a paper in the *Proceedings of the London Mathematical Society*, has proved surprisingly important.

The centenary of his discovery - that elastic waves can be guided by a surface - is memorable for the contradictions which it encompasses: on the one hand, Rayleigh's assessment of his classic 1885 paper as a rather minor mathematical development with a potential value only in seismology; on the other, the rediscovery of the subject in a totally different field - that of electronic signal processing - which has led to its explosive growth over the last twenty years.

In fact in his 1885 paper, *On waves propagated along the plane surface of an elastic solid*, Rayleigh writes:

‘It is proposed to investigate the behaviour of waves upon the plane surface of an infinite homogeneous isotropic elastic solid, their character being such that the disturbance is confined to a superficial region, of thickness comparable with the wavelength. It is not improbable that the surface waves here investigated play an important part in earthquakes, and in the collision of elastic solids. Diverging in two dimensions only, they must acquire at a great distance from the source a continually increasing preponderance.’

There were two domains in fluid mechanics in which Rayleigh made explicit use of hydrodynamic similarity: the theory of aerodynamic drag, and the treatment of the Aeolian tones. His ideas had a great impact on the development of hydrodynamic similarity theory and applications during his lifetime and beyond.

Rayleigh was a modest and generous man. He donated the proceeds of his Nobel Prize to the University of Cambridge to build an extension to the Cavendish laboratories. On receiving the Order of Merit in 1902 he said:

‘The only merit of which I personally am conscious was that of having pleased myself by my studies, and any results that may be due to my researches were owing to the fact that it has been a pleasure for me to become a physicist.’

His Presidential Address to the British Association in Montreal in 1884 summed up his philosophy:

‘Without encroaching upon grounds appertaining to the theologian and the philosopher, the domain of natural sciences is surely broad enough to satisfy the wildest ambition of its devotees. In other departments of human life and interest, true progress is rather an article of faith than a rational belief; but in science a retrograde movements is, from the nature of the case, almost impossible. Increasing knowledge brings with it increasing power, and great as are the triumphs of the present century, we may well believe that they are but a foretaste of what discovery and invention have yet in store for mankind. The work may be hard, and the discipline severe; but the interest never fails, and great is the privilege of achievement.’

Rayleigh died on 30 June 1919 at Terling Place, Witham, Essex. His son and biographer, Robert John, succeeded to the title in 1919 and continued in his father's footsteps, being a Fellow of the Royal Society and professor of physics.

21 March 2002

Noisy neighbours

Bob Russell (Colchester): I wish to dedicate this debate to the memory of the late Spike Milligan, who was the patron of the Right to Peace and Quiet Campaign, predecessor to the Noise Network and a great supporter of the UK Noise Association, which was formed in 1999 as the umbrella organisation for various groups involved in the battle to combat noise. Over the years, Spike attended many events in the Jubilee Room to meet Members of Parliament and highlight noise issues with them. I am told that he had a personal dislike for piped music and noisy neighbours.

The UK Noise Association, which receives a grant from the Joseph Rowntree Reform Trust, campaigns - perhaps too quietly, for I wish it were better known - to reduce noise in our everyday lives, and to silence, or at least quieten, the cacophony of noises that disrupt what we would like to think is civilised living. The noise fighters can hardly shout from the roof tops, so I shall speak up for them this evening.

I also wish to place on record the excellent work of Mrs Val Weedon, who formed the Noise Network as a result of her experiences with a particularly annoying noisy neighbour and who has subsequently been awarded an MBE for her unstinting work in seeking to reduce and eliminate noise. She is secretary of the UK Noise Association.

A noise is a noise is a noise. Noise annoys, but it can do more than annoy; it is increasingly causing more and more people considerable distress, ill health and, in some cases, it ends in death - the victims take their own lives because they cannot put up with things any longer, or they take the law into their own hands and kill the perpetrator. It is estimated that every ten weeks, on average, someone dies as a result of neighbour-noise conflict.

The negative impact of noise in society is recognised by the Government, and I welcome the publication

late last year - five days before Christmas - of a consultation paper from the air and environmental quality division of the Department for Environment, Food and Rural Affairs.

Unacceptable noise is not just an urban issue, for I suspect that an early morning crowing cockerel may not be everybody's idea of a welcoming dawn chorus: it is a sound that country folk should accept as being part of rural life, whereas it would not be at all popular in an urban setting.

I use that illustration to make the point that what is an unacceptable noise for one person can be perfectly acceptable to another. It is a question of common sense and fairness. Thudding heavy-metal music is unbearable at any time - unless people like it. In my opinion, it is a form of non-physical thuggery for someone to inflict it

**FROM HANSARD****Adjournment debate**

on others, particularly during the traditional quiet hours of night and Sunday afternoons. I understand that the consultation period for DEFRA's proposals, entitled *Towards a National Ambient Noise Strategy*, ended on 15 March. Perhaps the Minister would be kind enough to state when the findings will be published and when he expects new measures to be taken to remove unacceptable noise from our lives. However, although I welcome the consultation paper, I must register my strong disappointment that measures to deal with noisy neighbours are specifically excluded. Having devoted a whole chapter to what is headed Neighbour Noise, its introduction states:

'This consultation paper has as its remit ambient noise - noise from transportation and industry - and thus explicitly excludes consideration of neighbour noise.'

If we are being asked to accept that the Government is serious about tackling the problems caused by the growing number of antisocial noisy neighbours, that is clearly a wasted opportunity. I shall return later to what Chapter 3 says.

According to the UK Noise Network, quoting a study by the University of Sheffield, our

towns and cities are ten times noisier than a decade ago. It is said that a fifth of the European Union's residents suffer a noise problem.

In its publication *Noise and Liveability*, the UK Noise Association states:

'Noise can be much more than just an irritant. It can damage people's health and education and blight their lives.'

It also states that noise tends to be more of a problem for poor people, who often live in noisy areas and do not have the opportunity to move away.

Noise comes in so many different ways - obvious examples are from road traffic, flight paths and railway lines, but there are many others. Tonight, however, in the limited time available, I shall concentrate only on the noise nuisances caused by neighbours - hence the title of my debate. I am told that the Government has issued a leaflet entitled *Bothered by Noise?*, which

advises residents what action is open to them if they suffer from noisy neighbours. Will the Minister inform me when that leaflet was last updated and where the public can obtain copies?

I understand that later this year the EU Commission will issue a noise directive. I am not sure whether this has prompted the UK Government to publish its consultation paper, but in any event both moves are welcomed provided, of course, that we see immediate and positive action.

I hope that the Minister will be able to offer us good news - that there will be action, and that the Government is determined to reduce noise and where possible eliminate it completely. If the Government could introduce 'Silence is golden' measures, that would be an opportunity for us to give three hearty cheers of approval. Yes, there is a place for noise, such as a standing ovation, which is unlikely tonight, musical delights, such as the last night of the Proms, and spontaneous loud cheering such as I witnessed three times on Saturday when Colchester United beat Queens Park Rangers 3-1.

Noise has its place, but that place is not transferring noise from one domestic dwelling to another or many others, or to their gardens. As the Prime Minister said on 24 April last year: "We need an improved local quality of life."

I am sure that he was not talking about his immediate next door neighbour but was making a generalisation. In support of the Prime Minister, I should again like to quote from what the UK Noise Association has told me: 'It is quite simple. Noise blights the quality of life of millions of people. Liveable communities will not be created across the country if the UK remains as noisy as it is today.'

If there is one thing worse than a noisy neighbour it is a neighbour who is deliberately noisy - someone who gets perverted pleasure from inflicting misery on others by deliberate acts of noise aggravation that he or she pursues with callous zeal. This can take the form of loud music at all hours of the day and night, early morning do-it-yourself builders who think that banging and electric drills are all right, binge parties that last for hours, and running

Extracts are provided by
Rupert Taylor FIOA

'Noise.... is increasingly causing more and more people considerable distress'

up and down carpetless floors and stairs. Unattended barking dogs are also a major cause of concern. There are many other examples of noisy neighbour behaviour. 'Love thy neighbour as thyself' is sadly so often lacking in 21st century Britain. It seems that the 24-hour lifestyle this country is increasingly witnessing has regrettably not seen some active participants realising that they must adapt their behaviour accordingly. What may be acceptable during normal hours is often totally unacceptable to the rest of society in the early hours.

I am sure that all Members can recount tales of woe and misery raised with them by anguished constituents who are at their wits' end. Examples I have in Colchester include a young man with an electric guitar who slept by day and played his guitar by night, ruining the sleep of the family next door. This ended only after months of distress when the council's environmental noise people confiscated his equipment and he was taken to court. Some may feel that a punch on the nose would have been more effective, but it would be wrong of me to support such direct action.

Another example is the couple living in an upstairs flat who felt that removing the carpet, as some form of fashion statement I believe, and constantly walking over the bare floorboards in heavy shoes was acceptable. The noise for the elderly lady living below was intolerable and she was forced to leave her home for days at a time to get peace and quiet elsewhere.

There have been numerous occasions involving loud music at all hours of the day and night, with open windows allowing the high volume sound to annoy the immediate neighbourhood.

We are told that there are powers to deal with such antisocial elements in society. Are they working? Are they strong enough? How effective are they? Evidence suggests that they are inadequate, and even when the powers-that-be get involved the process is time-consuming and slow. What is the Government going to do about it?

Mr Colin Daines, environmental control manager for Colchester Borough Council tells me: "Whilst legal controls may be improving, the derisory fines imposed by magistrates for the noise and other environmental offences that we do take to court do not seem to reflect the seriousness of the problems and the major effects they can have on those who are suffering them. We do try to educate our local JPs but any assistance from 'above,' eg via the Home Office, would be welcomed."

Chapter 3 of DEFRA's document says that neighbour noise is not part of the consultation. It outlines a catalogue of measures which, if they are to be believed, will provide a framework to ensure that England is a green and pleasant land, where at all times neighbour quietly speaks peace unto neighbour, where the only noises to be heard are the twittering of songbirds and the joyous laughter of small

children playing - and over there we can see pigs flying past.

The world is not like that, and the consultation paper is wrong to con us into thinking that there is adequate legislation - let alone an enthusiasm from local authorities, the police and other agencies - to deal with noisy neighbours. The theory is fine: the reality is somewhat different. In explaining why neighbour noise does not form part of recent noise strategy consultation, the consultation paper states: 'Neighbour and local neighbourhood

noise is a major source of disturbance to many people and can have a significant impact on quality of life and the local environment. This chapter summarises the legislation available to local authorities and others to deal with neighbour noise. It outlines the positive actions being taken to provide local authorities and others with effective powers to address complaints about neighbour noise and to raise the general awareness of the impact that the generation of noise can have on others.' The legislation is clearly not working. Noise complaints are increasing, certainly in my constituency if my postbag and advice bureau are a good guide. The Acts of Parliament that we are told 'provide powers to address neighbourhood noise' are: the

Environmental Protection Act 1990, Part III; the Noise and Statutory Nuisance Act 1993; the Noise Act 1996; and the Control of Pollution Act 1974, Part III. I am advised that a consultation

is under way to seek views on whether, and in what way, the Noise Act should be reviewed. There is compelling evidence that something must be done.

An indication of how seriously noise is regarded as an issue by the Government is reflected in the statement in the DEFRA consultation paper that the Noise Forum - yes, there is such a body - 'meets twice a year and provides an opportunity for the exchange of information and views between those affected by noise and those who have a responsibility for dealing with it'. Twice a year? I hope the Minister will agree that meeting twice a year is hardly an acknowledgement that tackling noise is high on the agenda.

It is not just noisy neighbours, however, who are to blame. The design of buildings, particularly flats and homes in multiple occupation, needs to be addressed. In total, an estimated 2.5 million homes in this country have bad sound insulation. The UK Noise Association published an excellent brochure last Friday week entitled: *A Sound Solution*. I am advised copies have been posted to every MP. It sets out a strategy to minimise noise nuisance in housing by using better sound insulation. I invite the Minister to support the aim of making our nation's homes quieter by design and construction, and that applies to new-build as well as the existing housing stock.

The National Housing Federation, which represents around 1,400 not-for-profit housing organisations that own or manage about 1.7 million homes in England, tells me that there is a need for all agencies to work together on individual cases to agree enforcement action, to provide support for those at risk and to intervene to help people address their behaviour.

It says: 'People displaying noisy and anti-social behaviour can cause a great deal of distress to their neighbours. We support our members taking swift and appropriate

enforcement action to deal with proven anti-social behaviour, such as racism, harassment and drug dealing'.

That is fine for housing associations and local authority tenants, but

we need to consider all cases of noisy neighbours. It is not just tenants who are bad neighbours. Indeed, the two specific constituency cases that I highlighted involved owner-occupiers.

The future does not sound good. Mr Richard Mills, secretary general of the National Society for Clean Air, commenting on the Government's draft national ambient noise strategy, said: 'There is a clear opportunity now to develop, for the first time in the UK, a coherent and strategic approach to the control of ambient noise. These proposals simply fail to meet the challenge. As things stand, nothing will prevent the noise climate in the UK getting worse for at least another five years, when all momentum will have been lost. Ministers promised us a strategy to tackle noise. Sadly, it's all quiet on the policy front.'

It is clear that legislation is not deterring noisy neighbours. It must be improved so that immediate action can be taken. If we can have neighbourhood wardens issuing on-the-spot fines for owners of dogs that foul the pavement and for louts who drop litter, why cannot we have noise wardens with the power to take immediate action against those generating unacceptable levels of noise?

I invite the Minister to accept the recommendation of the UK Noise Association, urging that more resources should be allocated by local authorities to provide a higher quality service with the employment of dedicated noise officers. Current experience throughout the country is that the level of service provided by local councils is variable.

The Government supports the European Convention on Human Rights, article 8, which establishes the right of respect for 'privacy, family life and home'. Article 1 of protocol 1 establishes a right 'to the peaceful enjoyment of your possessions and protection of property'.

The human rights of the victims of noisy neighbours are being infringed. The Government has a legal obligation to ensure that legislation is adequate. The Government may not have been entirely silent on the question of noisy neighbours, but it needs to do a lot more to tackle one of the great social miseries of modern times.

'Nothing will prevent the noise climate getting worse'

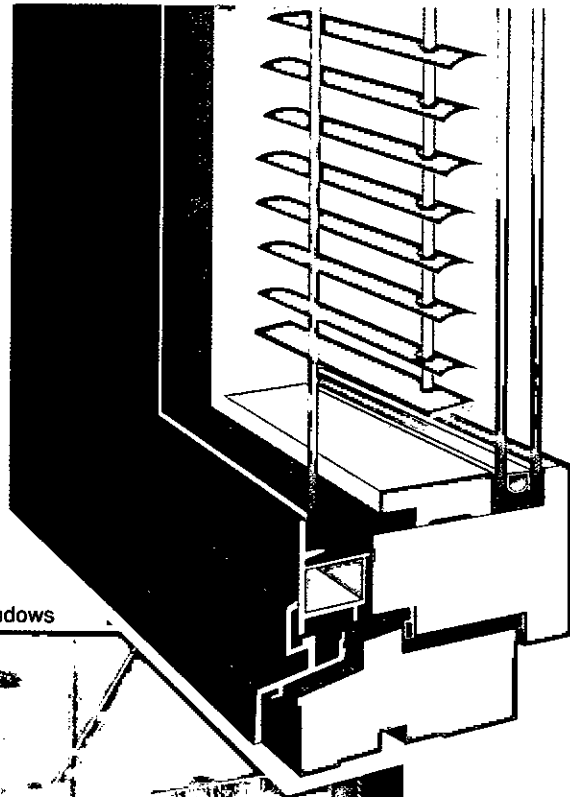
'The legislation is clearly not working'

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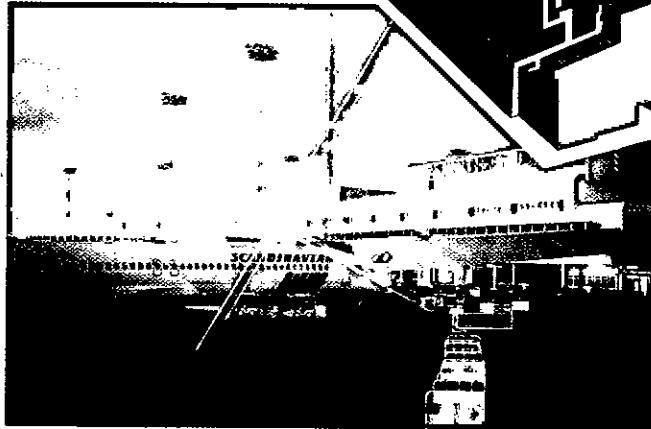
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Fool's Day spoof or journalistic irresponsibility?

I was greatly amused by the article in the March/April issue on the use of the Casella sound level meter by the *Autocar* journalists. This was intended to be an 'All Fool's Day' joke - wasn't it?

I am not a great fan of the philosophy that every possible risk in our society has to be eradicated by more and more rules and controls. I have in mind here the issue of use of mobile telephones in cars. I believe that hand-held phones are a potential hazard because one is forced to drive with one hand occupied, but hands-free phones are far less of a risk than back seat mothers-in-law, arguing spouses, travel-sick children, etc.

I feel that the considered use of the auditory function to conduct a conversation with someone who is not in the vehicle is not a serious degradation of one's intellectual functions. Now I am sure that there will be many professional psychologists who will disagree with my views. That's democracy. However, there will be very few who would disagree with me that actually taking one's eyes from the road to read a sound level meter is just plain irresponsible, or even grossly stupid. Tell me, at just what speed was the Lamborghini travelling when the noise measurements were taken?

I wonder if the IOA will be adding a 'Certificate of Competence in in-car noise measurement' shortly? There could be a ready market for such a service, it being self-renewing, as those journalists that hold the Certificate would probably not have a long life expectancy. Nor would those that share the roads with them.

Eurling Dr S A T Stoneman

How can we be sure noise maps are accurate?

I am interested to know whether any other members share my concerns about noise mapping. While I am, of course, aware that under the new EU Directive there is a requirement to produce noise maps of all conurbations of significant size, I am very worried by the way in which noise mapping has been accepted, apparently without question, by the acoustics community in this country.

Few people - neither the potential users nor the developers and suppliers of noise mapping software - seem to be interested in the accuracy of the maps produced. Yet what is the value of noise maps if the noise levels predicted do not reflect the real (current or future) noise climate?

When the producers of software are questioned about accuracy, the answer is usually along the lines of 'We've compared the predictions with measurements and they are very accurate' or 'The predictions



David Bull FIOA with his award for services to the Institute, presented at the Spring Conference 2002

Why younger members should get involved

The award that I received at the Spring Conference was very unexpected - a very pleasant surprise. I have enjoyed the twenty or so years in which I have been directly involved with various activities of the Institute. The experience has been stimulating and rewarding.

However, if the Institute is to thrive and develop further more younger members are needed to contribute to the activities, in particular to local Branches and to specialist groups. After all it is your professional body and its activities will

reflect the input from willing volunteers; the Institute needs you! I have found the old adage - 'you get out what you put in' - to be so very true.

I would like to place on record my grateful thanks to all those colleagues who have helped me in many different ways over the years. Also my special thanks must go to the staff at headquarters who have never failed to be understanding and helpful, even in the most difficult of circumstances.

David Bull

are within 2 or 3 dB of measured levels'. Yet no data is produced to substantiate these claims. It is interesting to compare this situation with the modelling of room acoustics, where many years of research have been devoted to validating and improving the accuracy of models.

Given the important role that the output from noise maps is going to play in future planning and noise control strategies, it is essential that those responsible for making decisions know how accurate the predicted noise levels are likely to be, and how much confidence they can place in the predictions. It is necessary for some form of quality control to be introduced so that mapping software can be shown, using a standard and transparent validation procedure, to be a reliable and efficient means of predicting and presenting noise data.

Another area of concern to me is the amount of time (and hence money) involved in the production of noise maps. The acquisition and input of data alone will take many weeks or months of a person's time. I understand that once the data is input, the production of a noise map of a large town can then take several weeks of computer time.

Is this really a sensible use of time and money? Most of the noise maps that I have seen show that the major source of noise in urban areas is traffic on main roads. I fail to

be persuaded of the need for sophisticated software to produce these maps. Most experienced noise consultants could produce an accurate noise map if given a street map and a red pen.

My most serious concern, however, is the way in which noise policy is currently being driven by noise mapping. This is very evident in the recent consultation document 'Towards a national ambient noise policy', which places a great deal of emphasis on noise mapping, and makes no mention at all of noise measurement. Indeed, the document redefines the term 'ambient noise' to mean only noise from transportation and industry, presumably as these are the only noise sources dealt with by noise mapping. I have always understood 'ambient' to refer to all the noise occurring at a given time in a given place, including, for example, noise from children, dogs, wind, rain, trees as well as noise from pubs and clubs and construction noise.

In my view, a national strategy to deal with all sources of environmental noise should be developed independently of noise mapping, although accurate noise mapping could well contribute to the implementation of the strategy.

Bridget Shield

Timothy Leighton FIOA is awarded the Medwin Prize 2001

During autumn 2000 the **Acoustical Society of America** announced a new prize in *Acoustical Oceanography*. A fund had been set up by Hank Medwin and his wife, which would be known as the *Medwin Prize for Acoustical Oceanography*. Very few rules were laid down, other than that the nominee should be under the age of 46 and must have made a significant contribution to the advancement of acoustical oceanography. The only other stipulation was that the prize must not be given to anyone who works purely in computer simulation of ocean acoustics. When I first saw the call for nominations, just one name came to mind as a potential nominee. This was **Prof Tim Leighton** from the Institute of Sound and Vibration Research, University of Southampton. Having previously obtained his CV for another purpose, I was able to draw on this to formulate the nomination letter. As part of the nomination I also provided the names of three eminent referees who, in turn, sent their letters of support to the ASA. A committee of world renowned acoustical oceanographers had gathered to preside over the nomination and decide who was to be the first recipient of this prestigious prize. In early April 2001 the ASA president tried to contact Tim to tell him that he had been selected as first recipient of the ASA Medwin prize. Unknown to the president, Prof Leighton had been away from the



Professor Timothy G. Leighton

office owing to health problems and his wife Sian had been diagnosed as requiring major surgery. Consequently the president contacted me, as Tim's nominator, requesting that I pass on the news. It was an honour to relay this message to my friend and colleague, and bring a ray of sunshine into what had been a very difficult time. I was also able to announce the award at the IOA *Acoustical Oceanography* conference held in Southampton during April 2001 (which had been jointly organised

by myself, Professor Leighton, Hugh Griffiths and Gwynn Griffiths). Prof Leighton was awarded the Medwin prize at the 142nd meeting of the Acoustical Society of America held in Fort Lauderdale, Florida. On the morning of 5 December 2001 he was introduced by Dr Peter Worcester (Chairman of the AO technical committee) and then invited to deliver an hour-long lecture entitled: *Surf zone bubble spectrometry: the role of the acoustic cross section*. This was presented in Tim's usual enthusiastic and dynamic manner, combining breakthroughs in both theory and experiment, and was well received by the audience. Peter Worcester introduced Tim, using major points from his nomination document, and concluded by saying that many of us would be proud to have achieved just a small percent of this in a lifetime. He added that Tim had done all this before he was 46. Had he looked closer at the CV he would have realised that Prof Leighton is not yet 40! A copy of the citation read out by Peter Worcester is given below. During the conference plenary session Professor Leighton was awarded the certificate and \$2000 prize. Unfortunately, Dr Medwin was not able to be present for the lecture or the first presentation as family health reasons prevented his attendance at the conference. He was pleased to see that this prize had not only been awarded to the most deserving person but also to someone outside the USA and an active participant in the Institute of Acoustics. I would like to add my personal congratulations to Prof Leighton and I was delighted to be present when he was officially awarded the prize.

Gary Heald FIOA

142nd meeting of the Acoustical Society of America

Acoustical Oceanography Prize Lecture

Citation: Timothy Leighton

The first *Medwin Prize in Acoustical Oceanography* will be awarded to **Professor Timothy Leighton** in the Plenary Session this afternoon. He received the Prize *'for the effective use of sound in the discovery and understanding of physical processes and parameters in the sea, particularly ocean bubbles'*.

Prof Leighton is Professor of Ultrasonics and Underwater Acoustics at the Institute of Sound and Vibration Research (ISVR), University of Southampton, UK. He graduated in 1985 from the University of Cambridge with a Double First Class Degree in Physics and Theoretical Physics. He obtained a PhD at the Cavendish Laboratory, Cambridge, in 1988. He was then awarded Senior and Advanced Research Fellowships at Magdalene College of Cambridge University and the Engineering Physics and Science Research Council (EPSRC).

'His research work is concerned primarily with the acoustics of bubbles'

He is a leading figure in four fields: acoustical oceanography, biomedical ultrasonics, cavitation, and industrial acoustics. The Medwin Prize recognises his contributions to acoustical oceanography. His research work in acoustical oceanography is concerned primarily with the acoustics of bubbles, in both theoretical and experimental form. At the age of 28, on joining ISVR as lecturer in underwater acoustics, he completed the monograph *The Acoustic Bubble* (Academic Press). He is author of over 150 other publications. He has organised three international conferences, the Institute of Acoustics Conference on Acoustical Oceanography (2001); the Fourth International Conference on Natural Physical Processes Associated with Sea Surface Sound (1997); and Bioeffects of Ultrasound (1992). He is a member of the Council of the

Institute of Acoustics, the Research Co-ordination Committee and the Underwater Acoustics Group Committee of the Institute of Acoustics, and a member of the Physical Acoustics Technical Committee of the Acoustical Society of America. He was a founding member of the Ultrasonic and Acoustic Transducer Group sponsored by the UK Department of Trade and Industry, and is a member of the advisory editorial board of *Ultrasound in Medicine and Biology*, Chairman of the Interdisciplinary Cavitation Research Group, and Editor-in-Chief of *Acoustical Oceanography* of the Institute of Acoustics. He is a Fellow of the Acoustical Society of America, a Fellow of the Institute of Physics, and a Fellow of the Institute of Acoustics. He was awarded the 1994 *A B Wood Medal for Underwater Acoustics* by the Institute of Acoustics. In 2000 he was awarded a Leverhulme Senior Research Fellowship by the Royal Society.

Dr Peter Worcester
Chairman, AO Technical Committee, ASA

Physical Agents (Vibration) Directive

Agreement has now been reached between the European Parliament (EP) and the Council of Ministers on the text for this Directive. The significant amendments to the common position text which were agreed are:

☐ The whole-body vibration daily exposure action value will be reduced to 0.5ms^{-2} (from 0.6ms^{-2} in the common position).

☐ Transitional periods before the limit values must apply, starting when the regulations are implemented in 2005, will be:

☐ 2 years for new equipment, down from 3 years in the common position, ie 2007;

☐ 5 years for existing equipment, down from 6 years in the common position, ie 2010;

☐ 9 years for existing equipment in agriculture and forestry, ie 2014, as in the common position.

Important amendments withdrawn by the European Parliament were:

☐ The EP proposal for a reduction in the whole-body exposure limit value: the common position daily exposure limit of



1.15ms^{-2} remains.

☐ The EP proposal for a derogation for agriculture and forestry.

The common position daily exposure action value and limit value for hand-arm vibration remain at 2.5ms^{-2} and 5.0ms^{-2} respectively.

A full copy of the common position text can be found on the EP web site at:

http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/c_301/c_30120011026en00010013.pdf

The agreed text was passed to the jurist-linguists of both the Council and the European Parliament to ensure that the legal and linguistic aspects of the text are correct. The agreed text was then submitted to the presidency in early April, and a period of six weeks is allowed for the proposal to be voted on in both the EP and the Council. This will be followed by a formal signing to adopt the Directive, and it will be published in the *European Journal* within a month or two.

Adoption was expected to be before the end of

May, and the HSE will then begin drafting the new regulations. Three years will be permitted to elapse before the Directive is incorporated into UK law. The process of drafting will include public consultation.

For more information: Rebecca Hathaway, Physical Agents Policy Unit, HSE tel: 0207 717 6976 fax: 0207 717 6199

e-mail: rebecca.hathaway@hse.gsi.gov.uk

Monkey business

Silence was anything but golden for environmental health officers dispatched on a bizarre mission to record the mating cries of monkeys. The delegation trooped off to Marwell Zoo in Hampshire, to record the levels of noise made by amorous gibbons who usually sound off at the park twice a day.

The exercise was to gain data to help members of the Isle of Wight Council's planning committee decide a controversial application to create a monkey sanctuary



near Newport. Objectors say the scheme should be rejected because of noise nuisance. So, with high-tech monitoring equipment in place, the party stood outside

the gibbons' enclosure last week and waited and waited and waited. The gibbons were supposed to sound off at about 11.00am. The officers were there in good time and, sure enough, at eleven the gibbons emerged. But while they swung around, somersaulted and scratched various bits of their anatomy, they made not a peep. The council delegation reported that they had sat around while the gibbons made monkeys of them.

The environmental health team will apparently have to return to the park to try to catch the gibbons in a more rampant mood.

[Let us hope they have learnt the difference between a monkey and an ape! Ed.]

European court will review night flight ban

Residents protesting against night flights over southern England recently suffered a setback in a legal battle to have them banned, when a European court agreed to reconsider its earlier finding that aircraft noise breached their human rights. In a serious blow to campaigners living near Heathrow, the European Court of Human Rights will rehear the case and assess the Government's claim that the original decision was 'seriously flawed'.

Ministers argue that the ruling could cost the Government between £400m and £2bn in compensation, and may force an end to night flights at other British airports. They also claimed the court had given insufficient discretion to ministers, who had to weigh up the economic benefits of night flights against their environmental harm.

A grand chamber of the court will now reconsider the case, which raises questions over the interpretation of the European Convention on European Rights as well as issues of general importance. It is only

the twelfth time the chamber has agreed to rehear one of the court's judgments. The 17 judges, who will sit in the next few months, have the power to overturn the original ruling, modify it, or leave it unchanged. In October 2001 eight anti-noise campaigners successfully argued that the loss of sleep because of aircraft noise suffered by residents under Heathrow's flight paths violated their human rights. Monica Robb, vice-chair of the campaign group representing the residents, said she was disappointed the grand chamber had given leave for the Government to appeal. She hoped the judges would reiterate their original decision and make the UK Government comply with it, so that night flights would finally be stopped. The campaign group represents thousands of people who had petitioned the Government over night flights and twice won judicial reviews against them without getting the flights stopped.

The court ruled by a majority of five to two

that the Government had breached article 8 of the European Convention on Human Rights because the 'state failed to strike a fair balance between the United Kingdom's economic well-being and the applicants' effective enjoyment of their right to respect for their homes and their private and family lives'. Britain had breached article 13 in that there was not sufficient redress for the residents under English law for their human rights.

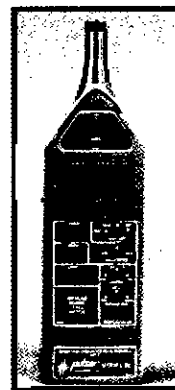
Each of the eight Heathrow residents, who have been fighting for ten years against night flights, was awarded £4000 damages for loss of sleep, plus a total of £70 000 to pay legal costs and expenses.

During the court case the residents had accused the Government of breaking its own promises on noise levels. In 1993 ministers said the flight quota would be set at a level to keep overall noise below that in 1988, but the residents claimed that within less than a year those levels had been breached.

Pulsar Instruments
Impulse sound level meters

The Model 51 type 1 and Model 52 type 2 hand held units from Pulsar Instruments are designed especially to be user friendly. They are intended for applications such as measuring general noise levels and for noise investigations within the workplace. Both meters are housed in diecast metal cases, which increases their strength, protecting them against knocks and bangs as well as the effects of electromagnetic radiation. With a depth of only 26mm, they are super slim and easy to handle. Model 50 series meters feature slide selector controls, which means there

are no complex menus to learn. Making measurements is as easy as flicking a switch. The clear LCD digital display has a back light which further improves the usability of the instruments. Both models can be supplied as complete measurement kits, listed as Kit 51 or Kit 52. These contain all the accessories needed to carry out noise testing. Specifically they include the Model 101 class 1L acoustic calibrator which complies with most codes of practice and current Health and Safety regulations, allowing on-site calibration before and after each measurement. For more information: Karen Archer tel: 01723 891662 e-mail: karen@pulsarinstruments.com



Model 52 sound level meter

Premier Electronics
Inexpensive GPS

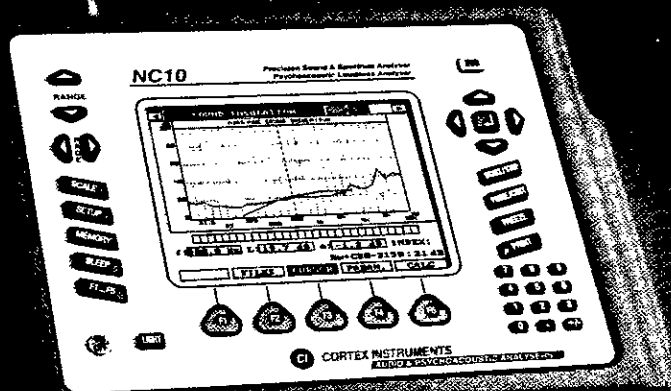
From Premier Electronics comes what it describes as 'the world's best Global Positioning System in a PCMCIA card format'. The complete system includes an external antenna and can be WAAS-enabled for accuracy to within 5 metres. This makes it suitable for applications that require precise positioning information, such as mobile measurement, data logging and tracking. By adding route-level software, it can create a portable satellite navigation system when plugged into handheld or laptop computers.

The PC card GPS will operate efficiently up to 60,000 feet, at 700 knots, and can withstand 4G acceleration. With a power consumption of only 38mA trickle, many new applications will become an economic reality. Even without the WAAS (wide area augmentation system) enabled, the standard positional accuracy using existing satellites is more than adequate for many consumer applications such as route finding. Compared with the expense of traditional in-car satellite navigation, the PC card GPS can enable an alternative at a fraction of the cost. Simply plug it into a portable computer running Windows operating software, add

suitable route-level map software and optionally buy a car-adapter kit (both also available from Premier). This will also allow the computer to be removed and used for other functions or transferred to another vehicle. The PC card GPS will also help to integrate new portable systems for detection, measurement, data logging and analysis where roaming needs precision tracking within 5 metres. The company provides full technical support for this PC card GPS, which is being stocked in OEM volume, at a retail price of £186 plus VAT. For more information: tel: +44 (0)1992 634652 fax: +44 (0)1992 634616 e-mail: sales@premierelect.co.uk

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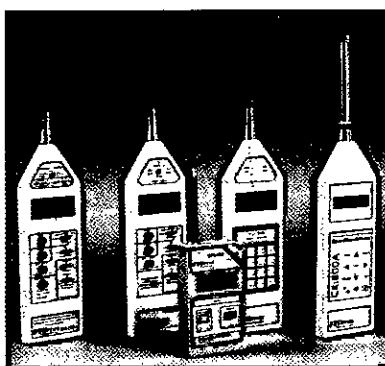
CORTEX INSTRUMENTS
 SOUND ANALYZERS & PSYCHOACOUSTICS

**Cirrus Research
Noise dose meters
developed further**

New developments to the doseBadge Personal Noise Dosemeter will be revealed by Cirrus Research at the Safety and Health Expo 2002. These include the measurement of time history, a new reader unit with a multi-function display, and a version of the doseBadge with intrinsic safety approval, for use in hazardous atmospheres. After the success of the exhibition in 2001, Cirrus is pleased to be returning to the NEC for what will be another busy show. At the show, the company's complete range of sound level meters and personal noise dosimeters will also be available for demonstration.

Cirrus can do DAT!

With the increase in neighbourhood noise complaints it is becoming more desirable



A range of the company's sound level meters and personal noise dosimeters

to have the ability to measure noise levels accurately and store an audio record of the actual noise. Systems must often be left unattended with the complainant as the majority of problems occur at night.

The Cirrus CR:281A noise nuisance recorder is a complete package which contains a DAT recorder together with a type 1 CR:831A data logging sound level meter in a secure enclosure. The CR:831A also provides octave and third-octave band filters and includes the Deaf Defier2 software. Options include a UKAS (NAMAS) calibration of the sound level meter and acoustic calibrator, as well as analysis software for more detailed investigation of measured noise levels.

Featuring a quick set-up procedure along with a simple, two-button remote control, battery or mains operation and all the accessories required including download and analysis software, remote microphone and acoustic calibrator, the unit is supplied ready for use at £3999.00.

For more information: James Tingay, tel: 01723 891655

www.cirrusresearch.co.uk

Cirrus Research is a Key Sponsor of the Institute

Sound Reduction Systems

Dr Roger Manifold joins technical team

Dr Roger Manifold has joined the expanding technical team at Sound Reduction Systems. His appointment follows three years as technical sales manager at CEP Acoustics where he was directly responsible for sales and promotion of the Coustone product. He brings with him a wealth of technical experience and a comprehensive knowledge of the acoustics market. Past successes include increasing sales figures and

product awareness for a range of companies and integrating businesses into various export markets, ranging from the Far East to the USA.

In his new role as SRS technical sales manager, Dr Manifold will reinforce the technical service delivered to customers and strengthen the company with his experience in acoustics.

For more information tel: 01204 380074 e-mail roger@soundreduction.co.uk website www.soundreduction.co.uk

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OOOOOOOOOO

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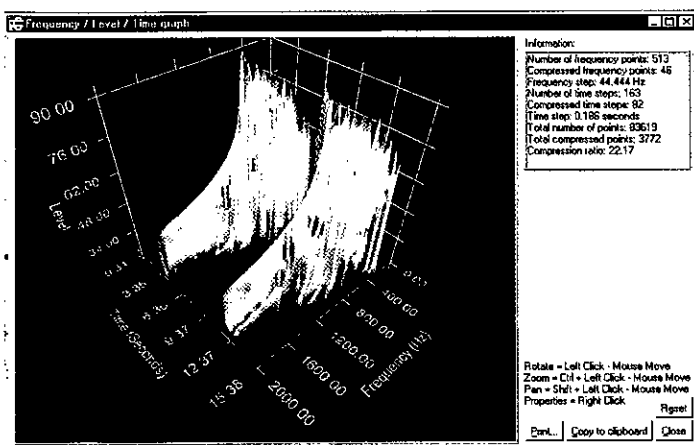
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A typical screen from the Casella frequency analyser

Casella CEL
New FFT narrowband frequency analyser

An innovative and powerful FFT narrow-band frequency analyser, the CEL-920, has been

launched by Casella CEL. This is a value-for-money, easy to use PC-based software package, with the power of a hand-held instrument. It may be used in a wide variety of applications including environmental assessment, source identification, noise and vibration control, and machine fault diagnosis.

The flexible system is able to convert existing sound level meters, tape recorders or vibration meters into sophisticated analysers, and has a type 1 approved hardware front end via USB connectivity.

According to David Billington, noise and vibration product manager, until now the combination of cost and sheer user-hostility of most FFT analysers has prevented their widespread use. This package makes sophisticated analysis and display techniques available to all, by simplifying the process and providing the technology at a low price. Its intuitive control is claimed to ensure that even occasional users are highly productive.

The manufacturer claims that the CEL-920 is sophisticated without being too complex. It is fast, taking approximately four minutes to install the software, run a live demonstration and analyse the test file. Automated routines are available which take the hassle out of calibration. Regular free workshops for users are planned.

For more information: David Billington
 tel: 01234 844100 fax: 01234 841490

Casella CEL is a Key Sponsor of the Institute

Acsoft
New Svantek sound analysers

Building on the success of Svantek's SVAN 912 handheld sound and vibration analyser, AcSoft now offers the company's latest models, delivering the same value for money in acoustic measurement, environmental noise monitoring, and occupational health and safety applications.

The SVAN 945 and 941 are respectively Type 1 and Type 2 approved digital sound level meters offering optional real-time frequency analysis, with 1/1 octave analysis standard in the 945, upgradeable to 1/3 octaves. The 943 is also an eight-hour noise dosimeter with selectable q, while the 945 provides options for loudness measurement, bark band analysis and pure tone detection. The advanced design of these handheld instruments combines powerful digital signal processing, for real-time analysis, including statistical calculations, with built-in standard weighting filters - A, C, Lin (flat) for the 943 and A, C, Lin(Z) and G for the 945. Noise measurements include SPL, L_{eq} ,



SVA 912 handheld sound and vibration analyser from AcSoft

SEL, statistics and TaktMax. Three acoustic profiles can be measured in parallel, with independently defined weightings and RMS detector time constants. This means that impulse, fast and slow measurements can be carried out concurrently, with time histories recorded in the 3MB memory buffer. Statistics may also be calculated in frequency bands when the real-time filter option is fitted.

These robust but lightweight instruments are powered for a full working day by a built-in rechargeable battery, with measurements stored in the 3MB non-volatile memory. Results can be viewed on an easy-to-read backlit LCD, or downloaded to a PC using the RS232 interface and SvanPC software.

For more information: John Shelton tel: 01296 682686 fax: 01296 682860

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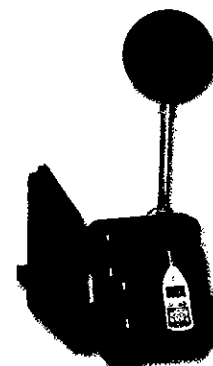
ANV Measurement Systems
Upgraded hire service

The instrument hire service provided by ANV Measurement Systems has been upgraded and is now principally based on Rion NL-31 Class 1 (IEC/CDV 61672-1) integrating logging sound level meters. The company believes it has the most modern sound and vibration hire fleet in the UK.

The Rion NL-31 is an ideal hire instrument because it is very easy to use and downloading the data requires no software, as it is stored as text files on removable compact flash memory cards, of the type commonly used by digital cameras. The data can be directly imported into spreadsheets via the PCMCIA socket of a laptop or a desktop card reader (supplied on request with the hired instruments). The unit can also be hired with a simple and effective outdoor protection kit.

A range of Rion sound and vibration products can be hired from the company, together with the simple and practical IFCO VM System which is ideal for logging PPV vibration levels from construction activities. The hire service is supported by a team of experienced UK noise and vibration professionals who can give practical advice on instrument use.

For more information: tel: 01908 642846
 web site: www.noise-and-vibration.co.uk



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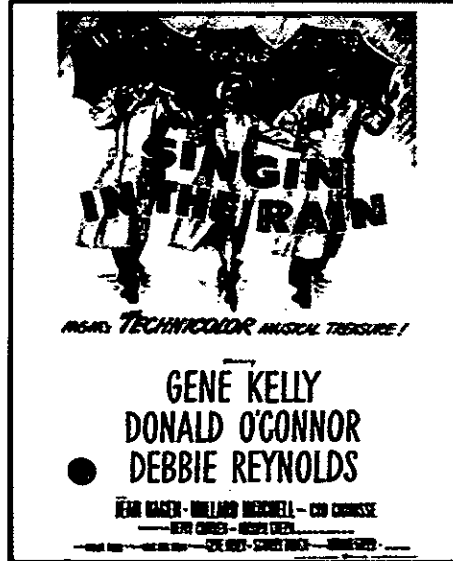
Acoustic Reflectors

One of the problems encountered by the first acousticians was the poor sensitivity of the microphones that were available in the early years of the last century. To overcome these problems, microphones were often used with concave acoustic reflectors to focus sound onto the cartridge and thus improve the sensitivity. These reflectors have a long and interesting history.

The original design was developed at the end of the 19th century. It was honed to perfection during the boom years in Hollywood as film directors found that by using a reflector, the actor's voice could be picked up with a microphone that was out of shot. This feature gave the director much greater artistic flexibility, avoiding the need to hide microphones in props on the set.

'starring' role

Film buffs will no doubt know of the famous occasion when the acoustic reflectors almost had a starring role in a Hollywood epic. This occurred during the making of the musical 'Singin' in the Rain'. The production of this classic film was beset with problems,



particularly in the outdoor scenes when the rain machines were found to create very high noise levels that were clearly audible on the audio track.

After several disastrous experiments with wind making devices, it was eventually found to be necessary for the actor to hold the acoustic reflector so as to maximise the signal-to-noise ratio achieved at the microphone. It was during the first 'take'

with the hand-held reflector that it was found to have a further useful property of keeping water off the microphone and thus avoiding damage to the very sensitive equipment in use at that time. In the final edited version of the film, you will see the reflector being used in most of the outdoor scenes.

Indeed, it is for this protective property that reflectors are most commonly used today, to the extent that very few people are even aware of the original concept behind the devices. As a science, acoustics has made many valuable contributions to humanity. Few of these contributions are as important but so little acknowledged as the acoustic reflector, or, to use its more familiar acronym, the Universal Microphone Background Energy Low Level Amplifier.



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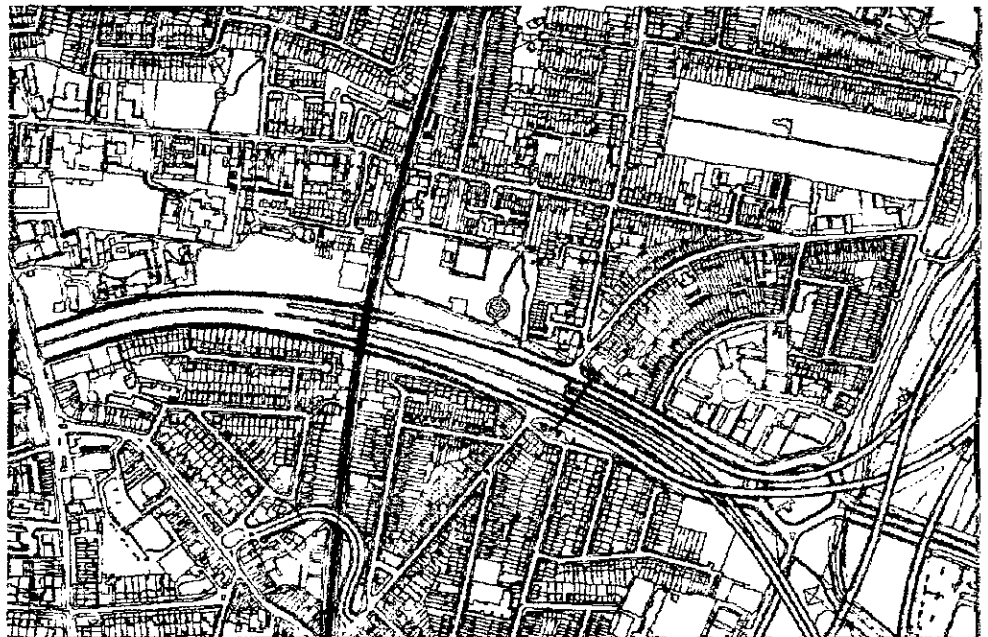
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Keith Anderson Rose RIBA FIOA

It was with great sadness that we heard of the death of Keith Rose. He died at home on 3 March 2002 from a heart attack. Keith was well known to many in the UK acoustics industry, in a variety of different ways. Keith had studied and qualified as an architect and became a member of RIBA, achievements in which he took immense pride. He spent the greater part of his professional working life until his official retirement with the architectural department of the BBC. He joined the BBC in 1962, as assistant to the then Acoustics Architect, Sandy Brown. That must have been something of a baptism of fire, but even then Keith probably gave as much as he received. In due course, after Sandy left the BBC to set up SBA, Keith took on that role himself.

His style of working was special. Never one to be unduly constrained by rules and management, his priority was always in 'getting the job done'. Many a time he would be seen sketching acoustic layouts with a felt-tip pen on the actual wall surfaces where his famous 'boxes' were to be placed. He also had an exceptionally well-developed ability to foresee potential acoustic problems at an early stage, particularly from the drawings. On site also, he could be the bane of clerks of works' and contractors' lives, and more than once had a construction demolished and rebuilt 'properly'. He did a great deal to promote awareness of acoustics amongst his colleagues, and organised annual acoustic seminars for that purpose. The fact that they always turned into 'social' occasions later on in the day only served to make them, and the topics, all the more memorable.

A management challenge!

To his management, Keith presented something of a challenge. He had an aversion to filling in forms, especially timesheets. However, his true value to his department, to his colleagues and to the BBC was recognised and always fully supported. He made significant contributions to virtually all of the present BBC premises and played a key role in the cost-effective development of Local Radio premises in the 1970's and 1980's. One of his enduring achievements, and well known to many acoustic practitioners, was the preparation and editing of the 'BBC Guide to Acoustic Practice' in its several versions. Containing a wealth of practical information gleaned through his experience with innumerable projects, Keith drafted most of the text and made all of the architectural drawings himself. The drawings illustrate the information in



a clear and concise form, characteristic of Keith's own desire to promote good acoustic design.

Advertisement management - a new role in retirement

After his retirement in 1992, he took on new roles, doing some acoustic consultancy, but more particularly in working for the Institute in the management of the advertising for the *Bulletin* and in organising the *Acoustics Index*. This continued his long-established contacts with manufacturers and suppliers of acoustic equipment and materials. His list of contacts and breadth of knowledge in the latter field was probably second to none.

In his private life, Keith was a dedicated family man. He found the time to get married and raise three children. In his earlier life, he had also been a keen sportsman, with significant achievements in cricket and water-skiing especially. He became an internationally recognised water-skiing judge and travelled widely in that capacity. He eventually became secretary of the British Water Ski Federation and was responsible for improvements there in the role of advertising manager - experience which came in useful again later on. He was a keen collector of antiques, though his large collection of vintage radios did not survive the later move to the Isle of Wight. He was also a keen collector of old acoustic measuring equipment, though most of that was actually used in

his work and resulted mainly from his self-admitted reluctance to embrace the latest technology. It had been something of a challenge to his colleagues, and resulted in the main controls on 'new' instruments being painted with colour codes for 'quick' access!

In his spare time, he converted and refurbished a pair of old cottages in Comberton near Cambridge - actually more of a rebuild than a refurbishment. After reconstructing at least one corner, which was slipping down the hill, and the roof, moving staircases and re-plumbing, re-wiring and re-decorating, it became a comfortable home in the country, a long way, physically and metaphorically, from the rigors of London and Henry Wood House. There he lived with Jan, whom he had met at the BBC and married in 1993, and the dog, Laurie. Keith, Jan and Laurie moved to the Isle of Wight in 1999. They quickly became part of the local neighbourhood scene, especially through the local pub, though Keith was by that time limited to only a glass or two of red wine. He

had suffered from some serious health problems at the time of his retirement. However, his two years on the island were blessed by his own relatively good health and constant activity, and the close companionship of Jan.

It was therefore a considerable shock to all for him to be taken so suddenly and unexpectedly. He died of a heart attack, in his garden, with his secateurs in his hand, after watching the Grand Prix at lunchtime and having visited an Antiques Fair in the morning. Keith enjoyed life to the full, and never more so than walking with Jan and Laurie or tending the garden.

An all-round commitment

Beneath his direct and usually brisk exterior, Keith was an exceptionally kind, selfless and considerate person, who would offer any amount of assistance to those who sought it. He was dedicated to his family, his house, his work even after retirement, and to the Institute and its members.

He will be sorely missed. Our thoughts and condolences go especially to Jan, to his three children Caroline, James and Matthew and to the other members of his family. Many others will also miss his cheerful contacts - members, staff and officers of the Institute, ex-colleagues both inside and outside the BBC, friends and neighbours, business acquaintances and many others. The world of acoustics has lost a dear and valued friend.

Bob Walker FIOA

Institute Diary 2002

22 May

One-day meeting: Weather or not to measure, Measurement and Instrumentation Group, Leicester

23 May

Diploma tutors and examiners, Education, St Albans

30 May

Publications Committee, St Albans

31 May

CCENM examination, accredited centre

6 June

Membership Committee, St Albans

11 June

Engineering Division Committee, St Albans

13 - 14 June

Diploma examinations, accredited centres

18 June

CCWPNA Advisory Committee, St Albans

20 June

Executive, St Albans

26 June

One-day workshop, Environmental Noise Group, Birmingham

2 July

CCENM Advisory Committee, St Albans

4 July

Medals and Awards, Council, St Albans

19 - 21 July

Auditorium Acoustics: Historical and contemporary design and performance, Building Acoustics Group, London

6 August

Diploma examiners' meeting St Albans

5 September

Bulletin board of management, Publications Committee, St Albans

6 September

Meetings Committee, St Albans

9 September

Research co-ordination, professional development, St Albans

12 September

Diploma tutors and examiners, Education Committee, St Albans

17 September

Engineering Division Committee, St Albans

19 September

Membership Committee, St Albans

26 September

Executive Committee, St Albans

9 October

One-day meeting, Did the Earth move for you? Measurement and Instrumentation Group, London

10 October

Medals and awards, Council, St Albans

23 October

One-day meeting, Environmental noise and health, London Branch, London

25 October

CCENM examination, accredited centre

29 October

Meetings Committee, St Albans

31 October

Publications Committee, St Albans

Inter-Noise 2002 International Congress and Exposition on Noise Control Engineering

Dearborn, Michigan, USA 19-21 August 2002

The Ohio State University and the Institute of Noise Control Engineering/USA are planning the International Congress and Exposition on Noise Control Engineering, which takes place from 19 to 21 August 2002. The Congress - the 31st in an international series - will be held at the Hyatt Regency Hotel and Conference Centre in Dearborn, MI, USA.

The theme of Inter-Noise 2002 is *Transportation Noise* as it relates to automobiles, trucks, motorcycles, off-road vehicles, trains, aircraft, and recreational vehicles. Over 525 abstracts have been received and 50 special sessions arranged on a variety of topics in noise control engineering. The theme will be emphasised by papers on vehicle noise sources, noise control methods and materials, building acoustics, modelling and simulation techniques, measurement techniques and community noise and environmental concerns.

Panel discussion

Special panels will discuss national noise policies and other contemporary technical issues. Professor Rajendra

Singh (Ohio State University) serves as congress president and Professor Ahmet Selamet (Ohio State University) chairs the technical programme. More information on the technical programme, travel planning, hotel reservation information, sightseeing tours and a registration form can be found on the web site.

Equipment expo

An equipment exposition has been organised: about 50 exhibitors will display the latest computer-based instrumentation, multi-channel analysers, sound quality systems, software for noise and vibration control analyses, acoustical materials, passive noise control devices, active control systems, and other products. The exposition manager is Richard J Peppin.

INCE seminar

A special INCE seminar on *Noise control methods: properties and effective use* takes place on 15-16 August 2002. The 2002 Sound Quality Symposium will be held at the same hotel on 22 August 2002, with a focus on human perception, acoustic modelling and the like.

A copy of the Inter-Noise 2002 invitation to participate is available from the congress secretariat, Department of Mechanical Engineering, Ohio State University, 206 West 18th Avenue, Columbus, Ohio 43210-1107, USA (e-mail: hp@internoise2002.org). This information is also available on the web site at: www.internoise2002.org

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