Acoustics Australia

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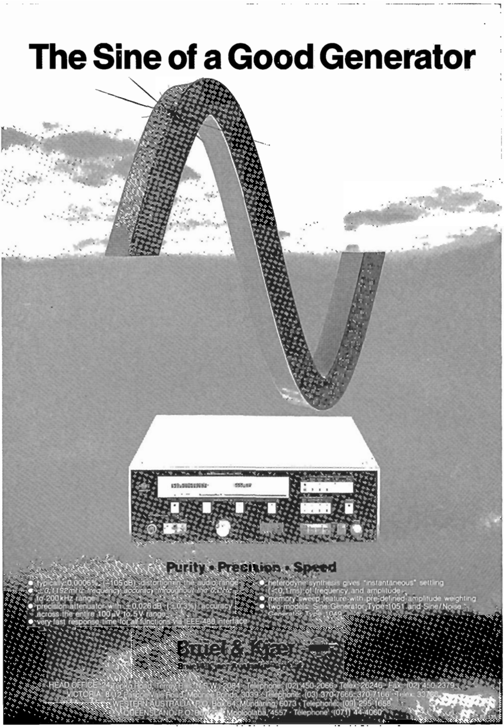
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The Chief Editor
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NEWS

A.C.T.

May Meeting

On 19th May, 1987, a small group attended a fascinating presentation by **Graham Caldersmith** on "The Physics and Tradition in Violin Making". This meeting was held in Graham's workshop/laboratory and commenced with a demonstration of the tone woods which are carved to form the front and backs of the instruments.

Graham explained his scientific approach to studying the vibration patterns of the parts of the violin and compared these with the traditional "tone tapping" which were used before signal generators and similar equipment were available (and are still used by some makers). Once the violin is assembled Graham investigates the radiated sound following excitation of the body with small transducers on the bridge. The drying of the varnish also has an effect on the vibration patterns.

Graham was complimented on his ability to present his investigations in a clear manner by the Chairman for the evening, **Howard Pollard.** The group later reconvened at a central restaurant and discussions continued over an enjoyable dinner.

Marion Burgess

N.S.W.

March Technical Meeting

The N.S.W. Division's March meeting included a visit to St. Mary's Basilica, Sydney, to hear **Basil Potts** (Sydney Grammar School and **Warwick Mehaffey** speak on and explain the ancient art of bell ringing. An inspection was also made of the recently installed (July '86) set, or ring, of new bells. These bells replace the old ring of eight bells cast by Messrs. Mears and Stainbeck, London, in 1881, and "are more worthy of one of the world's great cathedrals".

There are fourteen bells in the new ring, cast by Whitechapel Foundries, London. and they range in size up the octaves from the massive C sharp tenor weighing 34 cwt. 1 qr. 3 lbs. (1,741 kg) to the A sharp extra treble with a mass of 5 cwt. 2 qr. 4 lbs. (281 kg). A fourteenth bell, the flat sixth, is tunded to B. (For a discussion on the acoustic characteristics see Acoustics Australia v 14, n 2, pp 35-41.)

The technique of ringing up and ringing down the bells was demonstrated. This involves raising the bell to the inverted resting position (raised) or lowering the bell from this position, which is the usual starting position, to the lower free hanging position. The technique of applying a resonance frequency force enables a 50 kg (female) bell ringer to lift the (1,700 kg) Tenor to its raised position.

The musical aspects of the evening began with an explanation by Basil Potts of some of the intricacies of the sequences in which the bells are rung. A five bell peal utilising all 120 order combinations was performed, lasting about ten minutes. It was noted that a similar seven bell peal would last about seven hours and a full eight bell peal (rarely performed) would last for some three days. Several different peals using eight, ten and twelve bells were rung to the appreciation of Society members.

The negative aspects of bell ringing (unwanted sound emission) were discussed by Warwick Mehaffey, with some case histories of bell tower acoustic treatments being cited.

John Dunlop

VICTORIA

March Technical Meeting

Members and guests were formally welcomed to the Acoustic Laboratories at C.S.I.R.O. Building Research Division by **Paul Dubout** — a task he performed some 14 years previously when the Acoustical Society held its first Technical Meeting in Victoria.

Acoustics work within the Division has, to a large extent, been concerned with the accuracy and precision of acoustics measurements. Demonstrations of work being carried out were conducted by various C.S.I.R.O. staff and covered the following topics:—

- The computerised measurement and analysis of acoustical signals.
- The effects of various parameters on the sound field within a reverberation chamber.
- The measurement of impact noise and the assessment of the effectiveness of various flooring surfaces.
- The measurement of sound power within an anechoic chamber.

April Technical Meeting

At this meeting **Dr. Roy Ford,** Reader in Acoustics, Salford University, Manchester, addressed the members. (Of late, Dr. Ford has been working with Dr. Charles Don at Chisholm Institute of Technology on ground impedance effects.) Dr. Ford's topics included a brief outline of work carried out at the Acoustics Department at Salford and more specifically the work he has been engaged in which included the Assessment of Community Noise and the Sound Insulation of Window Units.

Salford University is one of two universities in the U.K. with an acoustics department. The department has measuring facilities which include reverberation chambers and an anechoic chamber. Work carried out by the department includes the testing of microphones, loudspeakers, building components and investigations into sound propagations outdoors. A consultancy service is also offered.

Work in community noise encompasses noise from aircraft, road and rail traffic, industry, construction sites and entertainment noise. For each different type of noise there is a different measurement unit. These different measurement units have been compared by some normalisation procedure for each of these noises. The results indicated that aircraft noise was the most annoying.

In the building components area, the work on double window units was made on units with airgaps of the order of 12 mm. It was found that improvements in performances could be better achieved by changing glass thicknesses than by increasing the airspace. Various other effects have been investigated, including the use of gases other than air in the space between the two panes, the absorption provided by fibrous and Helmoltz type absorbers in window reveals and laminated glass.

Joseph Mathew

Australian Acoustical Society

Conference on Seismic and Underwater Acoustics

Thursday, 28 January, 1988

University of New South Wales Sydney

A Bicentenary Congress of Physicists will be conducted in Sydney during January 1988 to coincide with Australia's Bicentenary Celebration. As part of the Bicentenary Congress the Australian Acoustical Society is organising a one-day conference on Seismic and Underwater Acoustics.

Contributions are invited for presentation at one of two sessions: "Marine Seismo-Acoustics" and "Water/Sea-Floor Acoustic Interaction". **Abstract deadline** is 16 October, 1987.

Professor Alick Kibblewhite of the Department of Physics at the University of Auckland will give the Invited Presentation to the Acoustics Conference. He will speak on "Geo-acoustics and the Interaction of Waterborne Sound with the Sea-floor".

An associated conference and workshop on ambient sea noise being held at the RAN Research Laboratory may also be of interest. Attendees are invited to participate in other activities of the Congress.

Registration forms and other details from:

Conference Organiser

Dr. John I. Dunlop

University of New South Wales
PO Box 1, Kensington 2033
(02) 697 4575

Program Organiser

Dr. Martin W. Lawrence
RAN Research Laboratory
PO Box 706, Darlinghurst 2010
(02) 692 1471

Notes from the Gen-Sec

I-INCE

The Thirteenth General Assembly of the International Institute of Noise Control Engineering will be held in Beijing at the time of Inter-noise 87. The AAS, which is a Member Society of the Institute, will be represented by A/Prof. Anita Lawrence.

Inter-noise in Australia

The AAS Council has recently decided to make a bid to hold an Inter-noise conference in Sydney in 1990 or 1991. In doing so it accepted a proposal from Unisearch Educational Services Unit, University of New South Wales, that they act as the conference secretariat and principal underwriters. M/s Jennifer Brett from the Unit in association with A/Prof. Anita Lawrence and Mr. Cliff Winters from the Society have prepared preliminary details and budget. A formal proposal will be submitted to the Board of I-INCE before the Beijing Inter-noise conference.

Annual General Meeting

The next AGM of the Society will be held at Hobart during the Society's conference "Acoustics in the Eighties" on 12 and 13 November, 1987. Any member wishing to bring any motion or business before the meeting must give notice in writing at least 30 days before the meeting.

AAS Council Meetings

The 39th meeting of Council will be held in Melbourne at the Australian Road Research Board on 9 and 10 November, 1987. The 40th meeting will follow the AGM in Hobart.

Ray Piesse

Overseas Scholarships

Scholarships to assist Australians working in scientific fields to visit **France** are available for three to six months during 1988. These scholarships are for Australian citizens at least 25 years old who have some knowledge of French and include an allowance plus assistance with air travel fares.

Further information: The Secretary, Department of Education, French Government Scientific Fellowships, P.O. Box 826, Woden, A.C.T. 2606.

* * *

A variety of scholarships are available for scientists resident in Australia to assist with exchange visits to **China, Japan** and **United Kingdom** during 1988. The deadlines for these applications are 1 September for U.K. and 1 October for the other countries.

Further information: International Exchanges Officer, Australian Academy of Science, G.P.O. Box 783, Canberra, A.C.T. 2601.

Position Vacant

The Noise Control Branch of the Department of Occupational Health, Safety and Welfare in Western Australia requires an **Engineer** or **Scientific Officer** for Noise Control. The salary range is $32,400 to $35,967.

For further information contact Pamela Gunn on (09) 327 8669.

I.C.A. News

Although **Neville Fletcher,** who is the Australian Representative on the International Commission on Acoustics, was unable to attend the April meeting in Rome he has advised of the following decisions from that meeting:

- Arrangements for the 1989 Congress, which is to be held in Belgrade, are proceeding well.
- The 1992 Congress will be held in Beijing, China.
- Professor Myncke (Belgium) has agreed to serve a further term as President of the Commission.
- Professor Kuttruff (Germany) will retire as Secretary and his place will be taken by Dr. Lord (U.K.).

Neville Fletcher has been asked to serve another three-year term on the Commission.

Inter-Noise 88

Inter-Noise 88, the 17th Conference on Noise Control Engineering, will be held in Avignon, France, from August 30 to September 1, 1988. The theme for the Conference is **The Sources of Noise** and the Call for Papers gives the deadline for receipt of abstracts at **October 31, 1987.**

Topics to be included are:

- physical generation and radiation mechanisms;
- measurement and analysis techniques;
- location, identification and modelling;
- stationary sources;
- moving sources;
- techniques for noise reduction at source;
- active noise and vibration attenuation;
- codes, regulations and labelling.

Further information: Inter-Noise 88, BP 23, F 60302 Senlis Cedex, France.

Call for Papers

9th International Acoustic Emission Symposium Kobe, Japan November 14-17, 1988

The purpose of the symposium is to bring together all who have had a significant involvement in applications, research, development and standards for acoustic emission. Four days will be devoted to invited papers, original papers, review papers and technical reports. Deadline for abstracts and preliminary application form is 31 May 1988.

Further details: Prof. Dr. I. Kimpara, Dept. Naval Architecture, Faculty of Engineering, University of Tokyo, 3-1, Hongo-7, Bunkyo-ku, TOKYO 113, JAPAN.

Standards

Audiometry Instrumentation

AS 1591.1. Reference Zero for Calibration of Pure Tone Audiometers is a revision of AS Z43, Part 2, 1970. It presents the levels in the coupler equivalent to those specified for the wide band artificial ear. The need for this data was brought about by the widespread use in Australia of the coupler specified in AS Z43 Part 3 and the significant practical advantages in specifying a reference equivalent threshold sound pressure level for the TDH-49 earphone and coupler.

Artificial Ear

The major reason for the revision of **AS 1591, Part 5,** Wide Band Artificial Ear, is to align with the recent International Standard ISO 389-1975/Add 1 — 1983, Standard Reference Zero for Calibration of Pure Tone Audiometers. The revised standard defines the requirements for an artificial ear covering the frequency range 20 Hz to 10 kHz, which is intended to be used in the calibration of earphones fitted with an earcap designed to press directly on the pinna of the ear.

Insert Earphones Calibration

AS 2928 deals with an occluded-ear simulator intended for the calibration of insert earphones in the frequency range 100 to 10,000 Hz in terms of the sound pressure at the ear drum. The aim is to simulate the complete ear canal for the calibration of earphones coupled to the ear by means of open mould fitting or similar device.

Hearing Aids

A new set of Standards **AS 1088, Parts 0-8** is an endorsement of I.E.C. Publications 118, Parts 0-8. The methods presented for the evaluation of the hearing aid electroacoustical characteristics are meant to be practical and reproducible and, consequently, they are based on fixed parameters chosen, to a certain extent, arbitrarily. The results obtained by the methods specified may deviate substantially from the performance of the hearing aid under practical conditions of use.

Effect of Intense Sounds

The Draft **ANSI S3.28 — 1986** (ASA Catalog No. 66 — 1986) describes a procedure for evaluating the potential effect on hearing of noises which consist of relatively intense sounds that might be generated by sirens, punch presses, jet aircraft, certain types of gunfire, etc. The procedures recommend integrating all sound with levels (A-weighted) from 80 to 140 dB if the sounds would expose the ear at any time to a peak A-weighted sound level above 120 dB.

People

After 16 years of slogging it out as the resident acoustical engineer at Addicoat Hogarth and Wilson in Sydney. **Ken Mott** has transferred to the Brisbane office. Ken was a member of the N.S.W. Divisional Committee for three years, during which time he was Committee Secretary and then responsible for the Technical Meetings. Ken is looking forward to meeting the members of the Queensland Division.

* * *

Meredith Rogers, who has been an active member of the A.A.S. and a member of the N.S.W. Divisional Committee, has been elected to the Council of the I.E.Aust. This is the first time a female has been elected to this Governing Body since the organisation began 68 years ago.

* * *

Wilkinson Murray Consulting Pty. Ltd. is likely to undergo a name change as a result of some internal company changes. **Peter Grifiths** will become a partner and director and **Roger Wilkinson** is rejoining the company as a consultant.

After only a short time of leisurely life in the A.C.T. following her resignation from N.S.W. University, **Marion Burgess** is now doing some part-time research work at the Department of Mechanical Engineering, Australian Defence Force Academy. She is assisting **Joseph Lai** with studies involving acoustic intensity and the use of the anechoic room (see Acoustics Australia V 15, No. 1, p. 14).

* * *

Vipac Pty. Ltd. has won a $750,000 contract to provide the acoustics and noise control consulting and testing services for the new Terminal 2 Building at Singapore's Changi Airport. It is the only overseas company to be working on the project. Scheduled for completion in 1989, the terminal has a total floor area of 285,000 square metres, with a six-storey main tower flanked by two four-storey buildings on either side.

* * *

New Members

- **Admissions**

We have pleasure in welcoming the following who have been admitted to the grade of Subscriber while awaiting grading by the Council Standing Committee on Membership.

South Australia
Mr. D. L. Hywood, Mr. N. Kroll.

Victoria
Mr. G. R. Campbell, Mr. F. E. Fleer.

- **Graded**

We welcome the following new members whose gradings have now been approved.

Student
Queensland
Mr. D. W. Manners, Mr. R. J. Trudgian.

Subscriber
South Australia
Mr. I. D. Shakes.

Member
New South Wales
Mr. J. S. Carigliano, Mrs. U. B. Mizia.

Queensland
Mr. D. J. Moore.

Victoria
Dr. C. G. Don, Mrs. J. C. Evans, Mr. M. J. Snell.

Western Australia
Mr. M. Pons.

* * *

DBR Retirements

Paul Dubout and **Bill Davern** are both taking early retirement from the CSIRO Division of Building Research. Paul will be the first to leave as his retirement is effective from early July. We understand that Paul is looking forward to enjoying a leisurely and quiet life. Bill will be retiring in October but prior to then will be on long service leave from July. Bill is planning a long overseas trip as his first "post work" activity.

Paul and Bill have both achieved international reputations for their excellent work in the Acoustics section at DBR. They have also been strong supporters of the Acoustical Society, having been members of Divisional Committees and having held important positions on the Federal Council of the Society. We wish them well in their retirement and hope that they continue to participate in Society activities.

Editorial

Once again there has been a minor outbreak of self-examination amongst technical journals. The two big issues of the day are production costs and nature of contents. Recently **ANZAAS** conducted a two-day forum on the subject following a survey of more than half Australia's estimated 250 technical journals in the natural and social sciences. In an article in the Sydney Morning Herald (29 May 1987) reporter Bob Beale commented: "Three-quarters of the surveyed journals are run at a loss, mainly by 'dedicated amateurs'. Most appoint editors for their specialist knowledge, not managerial skills. Few carry advertising. Members of learned societies, universities and taxpayers pick up the tab. Total costs for the 140 journals in the survey were more than $7 million."

Peter Judge of ANZAAS commented: "Most of the people involved are doing so while sitting at a desk in a university, the CSIRO or some other body. That represents a fairly whacking hidden subsidy, but it's usually tacitly approved or actively encouraged."

In the November 1986 issue of the Journal of the Acoustical Society of America, the Editor-in-Chief, **Daniel Martin,** discusses the associated question: **'For Whom are We Writing?'** He quotes the former editor, **Bruce Lindsay,** who wrote in 1964: "It must be recognised that the science of acoustics is continually growing in number of fields of application and in sophistication of treatment. The articles in JASA have, therefore, tended over the years to become more technical and specialised and, hence, less readable by the whole group of those who turn to JASA for information and guidance. All scientific periodicals are facing this problem in increasing severity."

Daniel Martin then comments: "The Editor believes that we write primarily for our peers within our fields of specialisation. For the purpose of increasing knowledge, this is laudable. However, especially in abstracts, introductions and conclusions of papers, every effort needs to be made to reach that important group of secondary readers, those who are unlikely to be familiar with highly specialised terms and abbreviations. To paraphrase **Professor Watson** (JASA Editor, 1933-1939), 'Try to explain it so others, less sophisticated in your subject, can understand it.' The Society is blessed with some authors who can already do this very well, and others who could do so."

"In his 1964 editorial, 'Applied Acoustics and the Journal', Editor Lindsay emphasised that 'in addition to reports of fundamental research, the Journal is hospitable to papers presenting unique and interesting examples of applications of well-known principles, well written and accurate, illustrated with appropriate graphs, charts and photographs but with a minimum of abstract mathematical analysis'."

In the case of Acoustics Australia, ours is a relatively costly production but one that we consider to be important, not only for disseminating new knowledge, but in keeping members and subscribers informed of current activities through reports and news items. Production costs in terms of percentage of the Society's income would decrease if and when the present drought in the business world breaks and companies feel free to advertise again. We grow weary of hearing a voice on the other end of the telephone intone: "Not this time — we have no money for advertising this financial year." We can perhaps be forgiven for thinking that many former advertisers and many newcomers to the world of acoustics do not in fact really exist at all. Do businesses in Australia naively believe that they can prosper by "word of mouth" techniques alone?

With regard to content, writers are often exhorted to pause before putting pen to paper and to meditate on the nature of the audience they are preparing to address. In writing for a professional scientific or engineering journal one tends to visualise a highly critical, sceptical audience of fellow workers or possibly an image of a judge (for judge read referee) weighing the contribution in a technical balance heavily biased against the author. It is natural for an author to feel cheated of his birthright if the sweat of his/her brow is criticised or, horror of horrors, actually rejected. This universal system is said to be necessary in order to maintain standards. As the **Australian Academy of Science** has put it: "No piece of scientific research work is complete until it has been written up, scrutinised by referees, and published in a journal accessible to the scientific peers of the author. Only then has it entered the continuing dialectic of science: it is subject to criticism, experimental test and interpretation in terms of various theories."

If the primary object of writing a technical paper is to disseminate knowledge, one wonders if a system that encourages the use of abstruse technical language, the elimination of redundancy and the use of mathematics as an argumentative device is not a better training system for the bureaucracy than one designed to catch the interest of fellow workers and hopefully to generate some kind of reaction other than sheer boredom.

Should we perhaps consider abandoning referees for technical articles other than those that clearly attempt to make a dent in the boundaries of knowledge? In that case, readability, interesting presentation techniques and well-designed illustrative material would be near the top of the list of criteria. Instead of a judge who is a specialist in the author's field, we would need approval from an *average reader*, assuming, of course, that the Standards Association or some other reputable authority could define and maybe show us where to find such an entity. Should our *average reader* be a member whose primary interests are in a different area of acoustics to that of the author or one who has no specialty interests at all (of whom there are many in our Society)?

At different times in the past we have asked for the following types of article to be submitted: research, review, tutorial or discussion. Maybe only the first type needs to be submitted to a referee, the other types of article simply being checked for intelligibility and presentation. To this list can be added short reports on current activities ranging in length from one to four pages printed. These are usually checked by one of the editors who functions for the occasion as an *average reader.* To date the majority of articles submitted have been of the research type. The question asked by our American cousins is just as relevant for us in considering the future direction we should take with Acoustics Australia: For Whom are We Writing?

Howard Pollard
Chief Editor

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National Noise Survey — 1986

Andrew Hede
Public Policy Research Centre
8-12 Ridge Street
North Sydney NSW 2060
Australia

David Meagher
Department of Conservation, Forests & Lands
240 Victoria Parade
East Melbourne Vic. 3002

David Watkins
Environment Protection Authority of Victoria
240 Victoria Parade
East Melbourne Vic. 3002

ABSTRACT: A social survey was carried out in February 1986 to assess the extent of community noise disturbance in Australia. A total of 2,332 people were interviewed in all federal electoral divisions. The results indicate that noise is the most serious form of environmental pollution experienced by residents. The noises which have the greatest impact on residential communities were found to be traffic and barking dogs. Twenty percent of Australian residents experience at least moderate annoyance because of each of these two noise sources. Overall, 40% of Australians experience disturbance to listening activities or to sleep because of some form of noise pollution. The most commonly reported causes of annoyance from individual motor vehicles in all states are hotted-up cars and motorbikes. The survey confirmed that complaint data is a poor indicator of the community impact of noise. Also, reaction to noise was found to decrease with age but to increase with education level. The present survey provides a baseline for future monitoring of the effectiveness of national noise control strategies in Australia.

1. INTRODUCTION

Studies of community reaction to noise in Australia have typically focused on either one particular type of noise or on noise in a particular location, e.g., aircraft noise [1]; traffic noise [2]; military range noise [3]. These studies have aimed primarily at establishing the relationship between the amount of noise and the reaction experienced by a community. There have been no studies aimed at assessing the extent of disturbance resulting from the many different sources of noise pollution throughout Australia. The present study aimed to fill the need for data on the overall impact of noise on the general population. The survey is referred to as the National Noise Survey. It was funded by the Australian Environment Council and carried out on behalf of the Council's Environmental Noise Control Committee.

2. METHOD

2.1 The Questionnaire

The number of questions in the survey was limited by financial constraints. The questionnaire was based on those used in previous noise surveys [1,3]. The items covered were: neighbourhood problems concerned about and affected by noises heard; disturbance to listening and sleep; noise annoyance; complaints about noise; most bothersome noise; motor vehicle noise; noise sensitivity.

2.2 Survey Procedures

The survey was conducted as part of a market research weekly omnibus survey, which entails personal interviews with approximately 10 respondents aged 14 years and over in each of the 110 federal electoral divisions in Australia. Interviews were carried out over two successive weekends in February 1986. The total number of respondents was 2332 and the sample breakdown by states was: NSW — 779; Vic. — 593; Qld — 408; SA — 199; WA — 199; Tas. — 80; ACT — 59; NT — 15.

3. RESULTS

3.1 Noise As A Neighbourhood Problem

The first two questions were designed to assess the relative impact on residents of the four major types of environmental pollution (air, noise, water, waste). To ensure an impartial response these pollutants were set in the context of other "neighbourhood problems". Respondents were shown a list of nine problems (presented in four different orderings) and were asked which, if any, of the problems:

— "are you, yourself, *concerned about*?";
— "are you, yourself, personally *affected by*?"

The results (Figure 1) show that noise disturbance is the most serious neighbourhood problem experienced by residents.

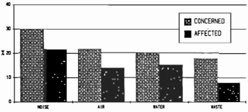

Figure 1: Percentage of respondents concerned about and affected by major types of pollution

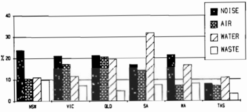

Figure 2: Percentage affected by major types of pollution in each state

Significantly more people were concerned about and affected by noise disturbance than by other pollutants. The rank order of neighbourhood problems which respondents were either concerned about or affected by is: (1) "noise disturbance"; (2) "unpleasant odours, smoke or dust"; (3) "poor tasting water"; and (4) "spilled garbage or litter". (Note that these were the terms used in the questionnaire and were chosen to be equivalent in their negative connotations for residents.) It must be pointed out that this study focused only on the impact of the various forms of pollution on residents. Of course, environmental pollution also has detrimental effects other than those on residents. In terms of these effects, noise may be a less serious problem than other pollutants.

While noise was the most commonly reported neighbourhood problem overall, there was some variation across states (see Figure 2). Noise was the problem most often reported as affecting residents in New South Wales (24%), Victoria (21%), Queensland (22%) and Western Australia (22%), whereas poor tasting water was the most commonly reported problem in South Australia (32%) and Tasmania (11%). Unpleasant odours, smoke or dust was the second most reported problem in Victoria (17%) and Queensland (21%), but was of less concern in Western Australia (7%).

Spilled garbage or litter was not rated highly in any state. Other neighbourhood problems reported in the survey were: not enough cycling tracks (21% concerned about, 10% affected by), not enough footpaths (16%, 9%), lack of trees (16%, 5%), not enough parks (14%, 5%) and ugly appearance of area (12%, 4%).

3.2 Types Of Noise

A number of reaction indicators were used to assess the relative disturbance caused by the different types of noise. Respondents were shown a list of 18 noises (again, four different orderings were used) and were asked to specify which:

- "noises do you, yourself, *hear* when you're at home?";
- "noises disturb you when you're *listening to TV, radio or music* at home?";
- "noises disturb your *sleep* at home?";
- "one noise would you *most like to get rid of*?".

Also, respondents were given a 0-10 rating scale with the extremes labelled "not at all annoyed" and "extremely annoyed", and were asked to rate:

- "how *annoyed* you are by (each noise heard) at your home?".

Table 1 gives a profile of the impact of each type of noise in terms of the percentage of respondents specifying the noise on the various reaction indicators. The noises in Table 1 are listed in rank order of their impact on residents (the primary indicator is "most like to get rid of").

TABLE 1
Profiles of reaction to different noises on a range of indicators
(figures are percentages based on total sample; "—" < 0.5%)

REACTION / TYPE OF NOISE	Noise heard	Disturbs listening	Disturbs sleep	Moderately annoyed	Highly annoyed	Most like to get rid of
Traffic	45	13	12	21	6	17
Barking dogs	45	8	15	21	9	16
Lawn mowers	44	9	2	13	3	6
Noisy neighbours	15	4	5	8	4	5
Trail bikes	13	4	2	7	4	5
Aircraft noise	24	9	2	8	2	5
Garbage collection	26	—	7	8	2	3
Neighbour's TV/music	14	4	4	6	3	3
Railway noise	17	5	3	6	2	3
Noisy parties	10	3	5	6	3	2
Burglar alarms	7	2	2	3	1	1
Construction noise	5	1	1	2	1	1
Entertainment venue	3	1	1	1	1	1
Sporting venue	4	1	—	1	—	1
Factory/shop noise	3	—	—	1	1	1
Air conditioner	4	—	1	1	—	—
Scare guns	2	—	—	—	—	—
Shopping centre	1	—	—	—	—	—
Other noise	2	1	1	—	—	2

3.3 Most Serious Noise Problems

The profiles in Table 1 indicate that the worst noise problems in Australia are traffic and barking dogs. Almost half the population hears these noises (45% "Heard" in both cases). Also, these noises were equally likely to cause moderate annoyance with 21% of respondents giving ratings ⩾4 in both cases. This indicates that each of these noise sources at least moderately annoys over 3 million Australians. However, barking dogs were more likely to cause high annoyance (rating ⩾8) which was reported by 9% of respondents as compared with 6% for traffic noise.

Activity disturbance is regarded as an important indicator of the community impact of noise. The two major disturbances were assessed in the survey, namely, disturbance to listening activities, and sleep disturbance. Overall, 40% of respondents reported experiencing disturbance to listening activities because of some form of noise, and 42% reported sleep disturbance. Listening to TV, radio or music was most likely to be disturbed by traffic noise (13% of respondents) and barking dogs (8% of respondents). Sleep disturbance was most likely to be experienced because of barking dogs (15%) or traffic noise (12%). No other noise caused a high incidence of disturbances to both listening and sleeping, although aircraft and lawn mowers caused considerable disturbance to listening (9% in both cases) and garbage collection caused considerable sleep disturbance (7%).

The extent of the activity disturbance caused by traffic noise and barking dogs explains why these two noises stand out as those which Australians regard as the worst noises. Almost one third of respondents selected them as the ones they would most like to get rid of (17% traffic; 16% barking dogs). Table 2 lists the percentage in each state who nominated each noise as the one they would most like to get rid of (only the top 10 noises are shown). It can be seen that traffic noise and barking dogs were by far the worst noises in all states. The next worst noise in each state was: NSW (garbage collection); Vic. (lawn mowers); Qld (aircraft); SA (aircraft) WA (noisy neighbours); Tas. (aircraft).

TABLE 2

Percentage of respondents in each state electing noises as the one they would most like to get rid of ("—" = < 0.5%)

NOISE / STATE	NSW	Vic	Qld	SA	WA	Tas
Traffic	15	18	16	18	20	13
Barking dogs	17	14	13	16	19	22
Lawn mowers	5	7	6	5	3	6
Noisy neighbours	5	3	6	2	4	2
Trail bikes	5	5	6	6	3	1
Aircraft	5	4	7	7	2	9
Garbage collection	6	1	2	2	—	—
Neighbour's TV/music	4	1	3	3	2	1
Railway noise	5	3	2	—	1	—
Noisy parties	2	3	2	5	—	—

3.4 Noise Complaints

The survey asked respondents whether they or any family member had complained about noise, and to specify which noise(s) and who they complained to. The incidence of complaint was very low and bore little relationship to the other indicators of noise reaction. The only noises complained about by more than 0.5% of respondents were: barking dogs (4%); noisy parties (3%); traffic, noisy neighbours, neighbour's TV/music (2% each); trail bikes, garbage collection, burglar alarms, entertainment venue noise (1% each). It is notable that lawn mowers, aircraft and railway noise are rarely complained about even though the other indicators of reaction clearly show that they cause considerable disturbance to residential communities (see Table 1).

Respondents indicated that when they do complain, most complaints are made to the police (27%), the local council (21%) or to a neighbour (21%). Complaints about barking dogs are mostly directed to either a neighbour (30%) or to the local council (29%), whereas most complaints about noisy parties are made to the police (70%), and about traffic to the local council (52%).

3.5 Motor Vehicle Noise

Respondents were also asked to indicate which, if any, of a list of noises from motor vehicles:

— "are you, yourself, *annoyed* by when you are at *home*?"

The results summarised in Table 3, indicate that the most common causes of annoyance to residents in all states are hotted-up cars (30% annoyed) and motorbikes (24% annoyed). Other frequently reported causes of annoyance were squealing brakes (19%), heavy trucks (19%) and general traffic noise (14%).

TABLE 3

Percentage reporting annoyance from motor vehicle noises in each state ("—" = < 0.5%)

NOISE / STATE	Total	NSW	Vic	Qld	SA	WA	Tas
Hotted-up cars	30	31	31	27	31	32	26
Motorbikes	24	25	24	24	26	19	12
Squealing brakes	19	18	22	11	25	20	12
Heavy trucks	17	19	16	17	11	17	9
General traffic	14	14	16	13	13	11	11
Car horns	9	9	10	6	9	9	5
Buses	3	4	2	4	1	1	—
Delivery vans	2	3	2	2	1	1	—
Other noise	2	2	2	2	—	3	2

3.6 Sensitivity To Noise

Noise sensitivity is known to be an important determinant of noise reaction. Respondents were asked how noise sensitive they were compared with other people. Overall, 10% rated themselves more sensitive, 21% said they were less sensitive and the majority (66%) considered themselves to be the same as other people. Of those rating themselves more sensitive, 25% reported having made a noise complaint, in contrast to only 11% complainants out of those who said they were less sensitive.

3.7 Demographic Factors

Community reaction was assessed in terms of the respondent's age, occupation, income, and education level. The only variables to show consistent effects on the various indicators of reaction were age and education level. There is a general tendency for noise reaction to decrease with increasing age, but to increase with higher education levels. These effects (which are illustrated in Figures 3A and 3B for overall noise reaction and for annoyance from the major two problems, traffic noise and barking dogs), occurred for virtually every reaction to every noise. Interestingly, a similar trend was evident for complaints.

4. DISCUSSION

The present survey has shown that noise is the most serious pollution problem affecting residential communities in Australia. In a comparable US study, noise was found to be as significant an environmental problem as air and water pollution [4]. Respondents in the present study appeared able to distinguish between the two reactions, "concerned about" and "affected by". The greater level of "concern" presumably reflects the fact that people will respond to socio-political aspects of environmental problems which don't "affect" them personally. This also highlights the need for investigators to be clear about the type of reaction they are assessing; where community annoyance and the impact on residents is under investigation, the reaction "concerned" is not the appropriate measure.

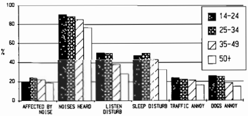

Figure 3A: Effect of age on noise reaction

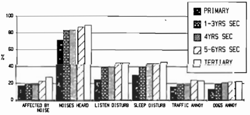

Figure 3B: Effect of education on noise reaction

The present results point to traffic noise as the number one priority in environmental noise control in Australia. The results indicate that more than three million residents experience at least moderate annoyance from traffic noise, and about two million suffer disturbance to sleep or to listening activities. It has been shown that traffic noise annoyance in Australia is increasing [5]. This increase cannot be halted unless a high priority is given to controlling traffic noise on a national basis.

The other priority in noise control is in the area of domestic noise. Three of the top four noise problems fall in this category, namely, barking dogs, lawn mowers and noisy neighbours. Another two, neighbour's TV/radio/music and noisy parties, also rated high in impact on residents (see Table 1). Responsibility for control of such noise in Australia generally rests with local councils and the police. However, a national educational campaign which fosters an attitude of consideration for neighbours would increase the effectiveness of domestic noise controls.

5. CONCLUSIONS

The main findings of the National Noise Survey can be summarised as follows:

1 In terms of impact on residents, noise is the most serious type of environmental pollution.
2 Forty percent of Australian residents experience disturbance to listening activities or to sleep because of some form of noise pollution.
3 The noises which cause the greatest disturbance to residents are traffic noise and barking dogs. Other domestic noises also have a significant impact.
4 The most commonly reported causes of annoyance from individual motor vehicles are hotted-up cars and motorbikes.
5 Complaint is a poor indicator of community reaction to noise.
6 Noise reaction tends to decrease with increasing age, but to increase with education level.

The present survey provides for the first time, a national perspective on the environmental noise problem in Australia. The results should be considered by regulatory authorities in deciding their future priorities for noise control. This study should be repeated in three years time and the results compared with the present baseline data to assess changes in the community impact of noise and to monitor the effectiveness of national noise control strategies.

NOTE

This study was conducted while all three authors were at the Environment Protection Authority of Victoria. The views expressed in this paper are those of the authors and do not necessarily represent those of the Australian Environment Council or the Environment Protection Authority. An earlier version of this paper was presented at the Annual Conference of the Australian Acoustical Society, Toowoomba, October 1986.

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Laboratory Rating of Steady-Flow Noise of Appliances Used in Water Supply Systems

Paul Dubout
Division of Building Research
CSIRO
Highett, Victoria

ABSTRACT: To assess the draft ISO Standard 3822 on behalf of SAA, ten different draw-off devices were rated in terms of appliance sound level, L_{ap}, in dB(A). A 95% confidence interval of ± 1.7 dB(A) in L_{ap} was achieved using normal techniques. Disadvantages noted were the tedium of exploring the noise characteristics of appliances as a function of water pressure and appliance throttle setting, and the cost and noise-vulnerability of the reverberation room required in this method.

To eliminate the reverberation room, the microphone within it, and the test wall which radiates into it, two alternatives were tried — accelerometers mounted directly on the test pipe, and hydrophones inserted directly into it. Both alternative methods provided similar precision to the ISO method; accelerometers improved the signal-to-noise ratio by 15 dB(A), hydrophones by 30 dB(A). The accelerometer method was found to correlate satisfactorily with the present ISO method; work by Fuchs in 1983 has shown that the hydrophone method also correlates well.
Keywords: Plumbing, noise, measurement.

1. INTRODUCTION

Noise generated by building services is a problem for many building occupiers. For example, some 12% of enquiries received at the CSIRO Division of Building Research (DBR) in a 5-year period, from persons wishing to alleviate a noise nuisance in their homes, were attributable to plumbing, heating, cooling or ventilating appliances in the enquirer's, or a neighbour's, dwelling [Ballantyne and Dubout, 1975]. Multi-family dwellings, hotels, motels and hospitals are especially affected.

Audible sound due to steady flow in a water supply system is nearly all generated in the control valves and draw-off taps, where relatively large water velocities are induced locally by throttling. Rapid fluctuations around the mean pressure occur in these zones, e.g. as large as 0.5 kPa r.m.s. amplitude of fluctuation, superimposed on the steady mean pressure of say 300 kPa in the pipes. The fluctuations are random in nature. All frequencies up to several thousand hertz (Hz) are present simultaneously in a continuously distributed spectrum.

There is usually nothing to prevent such pressure fluctuations from propagating as waterborne sound waves, both upstream and downstream from the point of origin. In addition, dilatational and flexural waves are induced to travel in the solid pipe walls, but the waterborne pressure waves are the major transmitter of sound energy to remote parts of the system. Since the pipe walls do receive some vibrational velocity, normal to the pipe axis, they are capable of radiating audible sound into the surrounding air, but only weakly due to their small area. Radiation is greatly increased if the pipe vibrations can couple through firm fixings to a wall of large area.

The noise generated by the much slower flow in other parts of the system — the pipes, bends and elbows — is usually negligible compared to the noise from the constrictions in the controlling appliances.

2. THE ISO MEASUREMENT STANDARD

A draft German national Standard appeared in 1971 for the first part of a laboratory method of rating the noisiness of appliances, and the International Organisation for Standardisation (ISO) based a draft on it. A somewhat modified international Standard was ultimately published, and has since been further amended [ISO, 1983]. Second, third and fourth parts have been added, specifying mounting and operating conditions for particular appliances [ISO, 1984].

Figure 1 illustrates the essentials of the ISO method. Water of measured steady flow rate Q (L/s) and pressure P (kPa) flows through a specified test pipe, then either through the appliance under test, or a specified reference hydraulic noise source, to discharge to atmosphere. The test pipe is fixed in a specified manner to a specified masonry or concrete wall.

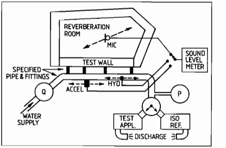

Figure 1: Essentials of the ISO method

The airborne sound power radiated off the far side of the wall creates a steady reverberant sound field in a room with reverberation time of specified frequency characteristic. The room sound pressure is space-averaged by one movable, or several fixed, microphones; and its level L_n is determined in decibels for each of six octave bands of sound frequency, centred at 125, 250, 500, 1000, 2000 and 4000 Hz, denoted by $n = 1$ to $n = 6$ respectively.

Figure 1 also shows an accelerometer and a hydrophone. The use of these alternative transducers will be described later.

The appliance is tested at a number of standard values of pressure P, viz. 100, 200, 300, 400, 500 kPa, and, if applicable, at several different settings of its own throttle valve; for example, for a draw-off tap: the fully open setting, the setting resulting in a flow of 0.25 L/s at the prevailing value of P, and the setting resulting in maximum appliance sound level.

The particular test rig is calibrated by performing a measurement on a copy of the ISO reference hydraulic noise source with the pressure set to P = 300 kPa. The 6 measured octave band sound pressure levels L_n for the appliance are normalised by adding the 6 differences (in dB) by which a specified set of 6 reference band levels L_{SRn} for the reference noise source, exceeds the set of 6 band levels L_{Sn} actually measured for it. Each normalised band level for the appliance (for a particular combination of P and throttle setting T) is called an appliance sound pressure level, octave band, and denoted by L_{apn}. Thus

$$L_{apn} = L_n + (L_{SRn} - L_{Sn})\ \text{dB}.$$

If the 6 L_{apn} values are each weighted by adding the appropriate weighting $k(A)_n$ dB (from the standard A-weighting curve, derived originally from the relative loudness of different sound frequencies to the human ear), then summed energy-wise, a single number A-weighted appliance sound level L_{ap} can be derived for the appliance, i.e.

$$L_{ap} = 10 \log \sum_{n=1}^{6} 10^{(L_{apn} + k(A)_n)/10}\ \text{dB(A)}$$

The specified set of 6 reference octave band levels L_{SRn} mentioned above is 35, 39, 42, 42, 37 and 25 dB. It was originally derived from field studies in typical apartment buildings in Germany. There, the same design of reference source, installed in place of a tap in a kitchen or bathroom, was, at P = 300 kPa, found to produce a sound level of about 45 dB(A) in living rooms of flats one floor above or below, with the spectral distribution indicated.

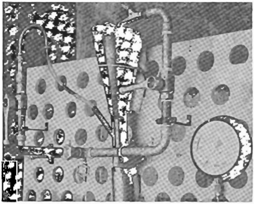

Figure 2: Reference noise source and test appliance on DBR test rig

3. EVALUATION OF THE ISO STANDARD AT DBR

Prior to the voting by nations on the draft ISO Standard, DBR undertook an evaluation of the ISO method, on behalf of the Standards Association of Australia (SAA). For the purpose, a 25 mm-bore test pipe was clamped to a 125 mm thick lightweight concrete wall slab set in the aperture between a pair of 200 m³ transmission-loss testing rooms. The reverberation time in the receiving room was adjusted to be constant at 2.5 ± 0.25 s.

Figure 2 shows the 25 mm steel test pipe coming in from the left, from the test wall, and arriving at a T-junction. The left branch, partly hidden, sweeps upwards through a low-noise on/off valve, shown in the open position. About 150 mm above this is a standard reference noise source, made at DBR to ISO specifications, followed immediately by a 180° sweep bend and a short 12 mm plastics tail pipe discharging into the stem of an open waste funnel. The right branch symmetrically sweeps up through an on/off valve (shown closed) and leads to the test appliance, in this case a single cold tap, arranged to discharge freely into the waste funnel. The funnel was damped and lined with foam plastic. The take-off point and needle valve below the T-junction lead to the pressure gauge on the right.

Figure 3 shows a closer view of the top of the RH branch, with a hot-and-cold basin set mounted for testing of its RH (cold) control tap, its LH tap being closed. In addition to these two appliances, a bath set, a shower set, a brass garden tap, and two WC cisterns had their noise emission characteristics thoroughly explored. Two graphical examples of results are given.

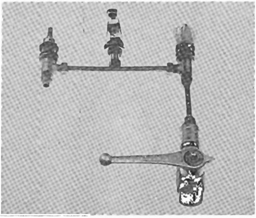

Figure 3: Hot-and-cold basin set mounted for test of its cold tap only

Figure 4, for the cold tap of a shower set, shows the family of 5 curves (one for each constant test pressure P) of L_{ap} dB(A) versus T%, the percent throttle setting of the tap. A throttle setting was quantified by the percentage T of fully-open-flow, that would occur at that setting for P = 300 kPa. This tap was probably the "best behaved" appliance we tested. Its curves did not intersect, they were relatively smooth, they were stable and repeatable whether the test sequence was obtained by increasing or decreasing T, and, for each pressure, maximum L_{ap} occurred at maximum T.

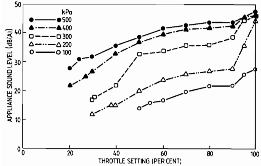

Figure 4: Curves of L_{ap} versus T for 5 values of P. Shower set, cold tap

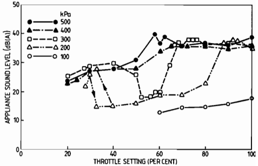

Figure 5: Curves of L_{ap} versus T for 5 values of P. Basin set, cold tap

For contrast, Figure 5 shows the complicated curves for the cold tap of the basin set. Except for P = 100 kPa, maximum L_{ap} occurred for T less than 100%, and the curves were very irregular. For P = 200 kPa, between values of T = 30% and 40%, the noise curve for a decreasing sequence of T could be significantly different from that for an increasing sequence. The latter branch was unstable — while traversing it, the noise would sometimes spontaneously jump up to the level appropriate to the decreasing branch.

Apart from this one instance of instability, the irregular curves for this appliance were elsewhere quite stable and repeatable. Note also that for each of the four highest P values the maxima of L_{ap} were all very similar in level, but generally a few dB(A) lower than for the "well-behaved" shower tap, at these pressures.

From the experience gained in using the ISO method to measure the noise emission from 10 different draw-off taps in the 7 appliances mentioned, we evaluated the method as follows.

(a) Due to the very low ambient sound level enjoyed at our laboratory site, resulting in only 20 to 23 dB(A) background noise level in our receiving room, we were able to explore the top 30 dB or so of the noise characteristics of these typical appliances. It would be costly to provide the same immunity from interference if the rig were to be set up in a general hydraulic and mechanical testing laboratory.

(b) Adjusting the reverberation time of the receiving room to be independent of frequency within close tolerances is a time-consuming process. (Subsequent to our work, these requirements were relaxed considerably by ISO.)

(c) By space-averaging with a microphone orbiting on 1.4 m radius, and for an averaging time of 160 s per measurement, we found our 95% confidence interval for repetition of L_{ap} values to be inside ± 2 dB(A). This includes variation in manual resetting of throttle position and the pressure regulator, and in reading flickering flow and pressure meters. By comparison with the precision achieved in other building acoustics measurements in the laboratory, this is an acceptable result. The apparatus and procedure would be suitable for research purposes as well as for routine rating of appliances, e.g. in development of hydraulic noise attenuators and anti-vibration-coupling mountings.

(d) Appliances can have complicated characteristics of L_{ap} as a function of P and T, and many measurements may be needed to determine them. Resetting of P and T for each measurement point is a tedious manual process, not very easy to automate.

4. TRIALS OF ALTERNATIVE TRANSDUCERS — Accelerometers and Hydrophones

In an attempt to eliminate the need for a specially adjusted reverberation room, with its vulnerability to interfering ambient sound, we soldered on 6 randomly distributed bosses along the outside of the test pipe, providing small flat surfaces for mounting accelerometers to measure the vibrational velocity of the pipe in a direction normal to the test wall. A passive electrical circuit between accelerometer and level meter performed one stage of integration, to provide a signal voltage proportional to the instantaneous velocity of the pipe wall. We also inserted 6 randomly distributed sockets through the bottom of the pipe wall, into which a sensitive pressure transducer (acting as a hydrophone) could be screwed, presenting its 11 mm diaphragm approximately tangentially to the inside surface of the pipe wall.

Our first comparative experiments were done on the garden tap. The results, for P = 300 kPa and T = 100%, are illustrated in Figure 6. Each point on each of the three L_{apn} curves is the mean of 60 measurements, each involving about 20 seconds of time-averaging of level, and comprised of 10 repetitions at each of 6 different positions for the transducer concerned. The A-weighted integral values, L_{ap}, for each curve are also indicated.

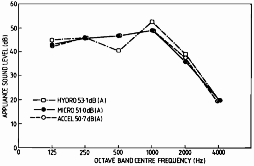

Figure 6: Comparison of L_{apn} and L_{ap} values obtained by the three methods — micro, accel, and hydro — for a garden tap at P = 300 kPa, T = 100%.

The agreement between the accelerometer method and the microphone (ISO) method was excellent at every individual frequency, and for the overall L_{ap} value. The hydrophone method showed two statistically significant departures from the microphone method, viz −6.3 dB at 500 Hz, and +3.2 dB at 1000 Hz. The associated L_{ap} was only 2.4 dB(A) higher than for the microphone. This was also a statistically significant difference, but it did not rule out the possibility of a satisfactory correlation between the two methods for determining L_{ap}, over other values of P and T. However, the strong systematic discrepancy in spectral shape at the one P,T point investigated was rather discouraging. We had only one pressure transducer, and moving it from socket to socket was very tedious so we decided to discontinue evaluation of the hydrophone alternative. As might be expected, by sensing the sound energy closest to the source, the hydrophone method enjoyed the greatest immunity to background noise, 60 dB(A), compared with 45 dB(A) for the accelerometers, and 30 dB(A) for the microphone.

We did a further series of comparisons of simultaneous measurements by the microphone and the accelerometer methods, using the single cold tap at 41 different (P,T) points, with up to 5 repetitions at some points, giving a total of 80 measurements by each method. Each microphone measurement involved 160 s of level-averaging on an 8.8 m orbital path; the accelerometer measurements were allotted 32 s for each of 5 different accelerometer positions.

Again, as for the garden tap, at high T settings we found good agreement between the accelerometer and microphone L_{ap} ratings. At medium and low T settings however, some irregular discrepancies of spectrum shape occurred, similar in magnitude to that illustrated for the hydrophone method in Figure 6. Nevertheless, for the overall appliance levels L_{ap}, the mean of the difference L_{ap} (accel) − L_{ap} (micro) over the 41 points was only −0.4 dB(A), with standard deviation only 1.6 dB(A). This is a little misleading, however, because the deviations were not purely random. There was a small but significant systematic dependence on both T and P. For example the mean differences within P groups were 100 kPa, −1.9; 200 kPa, −0.9; 300 kPa, 0.4; and 400 kPa, 1.0 dB(A).

From data on repeated measurements on the 300 kPa contour, with the amounts of space and time averaging indicated above, we were able to estimate and compare the 95% confidence intervals for repetition of results, by the three methods. As regards L_{ap} in dB(A), these intervals were microphone, ±1.7; accelerometer, ±1.5; and hydrophone ±0.7. The first two estimates are averaged over 11 different T settings, 5 repetitions at each; the last concerned 10 repetitions, for T = 100% only, and thus did not include any variation due to uncertainties of resetting T, as the other two did.

5. CONCLUSION

Of two alternative measuring systems investigated, intended to eliminate the need for a costly and noise-vulnerable reverberation room in the microphone method, the on-pipe accelerometer method was found to have about 15 dB more immunity to interfering noise, essentially the same precision (repeatability), and over a full (P,T) range for one appliance, a close correlation with the existing ISO microphone method.

This correlation was perhaps not close enough to warrant substitution of accelerometers for microphones, if continuity with past measurements by the microphone method were considered highly desirable.

The in-pipe hydrophone method was investigated for only one (P,T) point for one appliance. It had 30 dB better noise immunity than the microphone method, and possibly superior precision. We did not foresee close correlation for L_{ap} (hydro) and L_{ap} (micro), because of the systematic spectral difference of L_{apn} values. As we found later for the accelerometer method, spectral discrepancies of this magnitude do not necessarily lead to unacceptable differences of overall A-weighted L_{ap} ratings. A paper from the German laboratory where the ISO method was originally developed [Fuchs, 1983] has since reported excellent correlation between the hydrophone and microphone methods using only one hydrophone position in the test pipe, for two pressures (300 and 500 kPa) and seven different appliances (presumably the L_{ap}-max point for each of them). Fuchs also reported about 60 dB signal-to-noise ratio for the method. He has foreshadowed moves to supplant the ISO (and DIN) methods with the hydrophone method.

With some of the disadvantages of the present ISO measurement method thus removed, its implementation in Australia and New Zealand would be eased. The *need* for it would not arise here, however, unless standards or government regulations were to be laid down concerning maximum permissible L_{ap} values for appliances in various building situations, as in Germany and France. Further research would be needed to enable recommendation of such limiting L_{ap} values; to determine a fair way to characterise a given appliance by a single L_{ap} (or related) rating number; and perhaps to determine a different set of L_{SRn} values better suited to local conditions, for example the common use of 12.7 mm o.d. copper pipe running to draw-off appliances, and the occurrence of timber framing, in Australian buildings.

6. ACKNOWLEDGMENTS

Thanks are due to my colleagues Mr R.L. Cowling (retired), who performed most of the measurements reported here, and Mr I.P. Dunn, who programmed the computer for data acquisition and analysis. This paper is similar in content to unpublished papers presented by the author at the 8th Biennial Conference of the New Zealand Acoustical Society, Auckland, July 1985, and at the World Plumbing Conference and Exposition, Sydney, September 1985.

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An Acoustic Radar for Atmospheric Studies

Ian Bourne

Physics Department
University College, University of New South Wales
Australian Defence Force Academy
ACT 2600, Australia

An Acoustic Radar has been developed by a research group in the Physics Department of the University College at the Australian Defence Force Academy, Canberra. The Radar is used to investigate motion and turbulence in the lowest few thousand feet of the atmosphere by measuring the characteristics of sound waves, which are weakly backscattered by irregularities in the atmospheric acoustic refractive index. The principle of the technique was initially developed in 1968 by the late Lindsay McAllister (at the Weapons Research Establishment, South Australia) and the technique has been developed at a number of international centres.

The principle of operation of the radar is as follows: a powerful pulse of sound is transmitted into the atmosphere using a transducer at the focus of a parabolic dish. The antenna is shielded by walls to inhibit the reception of background noise. The antenna is also used to receive the backscattered signals whereupon they are amplified and spectrally analysed so that the amplitude, doppler shift and spectral width of the echoes can be determined. The doppler shift (i.e., the difference between the transmitted and received frequencies) results from the radial motion of the air's motion. If three antennae are employed, one vertical and the other two inclined from the vertical and pointing to the north and east, the various doppler shifts enable the wind's vertical velocity and horizontal speed and direction to be determined. The spectral broadening is a measure of the magnitude of the small scale turbulence. Time series of samples enable three other important parameters to be determined, namely, the depth of the night-time radiation inversion, the depth of the atmosphere which is well mixed in the daytime and the size of the largest turbulent eddies. Considerable data processing is required; the electronics unit uses four specially designed microprocessors and IBM XT personal computers are used to log the data.

The figure shows three antennae at a field site near Canberra Airport. The electronics are located in a small hut in the background. This system is used for research and development and is being used for a study of the occurrence of conditions resulting in fog at the airport.

While it is difficult to study the atmosphere at heights above a few hundred feet, there is considerable interest in this region and the radar has found many practical applications, some of which are listed below:

1. Monitoring atmospheric conditions conducive to the anomalous propagation of high frequency radio waves.
2. Monitoring wind shear near airports.
3. Monitoring conditions as the Space Shuttle approaches its landing site.
4. Monitoring conditions when very large balloons are being launched.
5. Monitoring conditions at nuclear power stations.
6. Monitoring conditions near large industrial works so that the plant operation can be adjusted to minimise the impact of any airborne pollutants on the environment.
7. Studying sites proposed for industrial development to determine their capacity to dissipate airborne pollutants.
8. Assessment of sites proposed for astronomical telescopes and wind-powered generators.

Acoustic radar antennae.

The Acoustic Remote Sensing Project at the Academy involves many aspects, including meteorology, the physics of turbulence, atmospheric dispersion modelling, analogue and digital electronics design, data management and substantial field work. The use of acoustics in the atmosphere will play a major role in a Joint Conference of the Remote Sensing of the Atmosphere and Oceans that will be held at the Academy in February 1988. On this occasion the International Society for Acoustic Remote Sensing has joined with CSIRO's Department of Atmospheric Research to bring together a wide range of scientists interested in various methods of remotely sensing the properties of the atmosphere and oceans. Any enquiries regarding the conference or the acoustic radar system should be addressed to Dr. Ian Bourne, Physics Department, University College, Australian Defence Force Academy, Campbell, ACT 2600.

Sound Advice for National Tennis Centre

Due for completion in time for the January 1988 Australian Open Tennis Championships, the National Tennis Centre in Melbourne will contain a centre court stadium plus additional courts and associated facilities. A unique feature of the centre will be an enormous retractable roof, 100 metres long, 30 metres wide and 9 metres high, operated by electric motors and sophisticated electronic control systems.

Being a world first, one of the unknowns about the retractable roof was its acoustical performance. Would the bounce of a ball cause confusing reverberations inside the tennis centre? Would public address announcements be absorbed and lost? Acoustical experts at the **CSIRO Division of Building Research** were asked to take measurements and find the answers to these questions before final erection of the massive roofing structure.

The 600 m^3 reverberation room at the Division was chosen as the most suitable facility in Australia for measuring the sound absorption coefficients and sound transmission loss of the roofing system.

A mock-up was constructed comprising the steel deck, mineral fibre insulation, polythene film and the 18 mm particleboard lining to be used in the final roofing system. All the measurements of the sound absorption coefficients and transmission loss of the mock-up were made over a period of less than 24 hours, due to the sophisticated measuring techniques used by the Division.

Results from the tests were favourable, with the roofing system performing substantially better than anticipated. The Division was able to report to Chadwick Industries, the roofing contractor, and Civil and Civic, the Project Managers for the National Tennis Centre Trust, that the roofing system meets the specified acoustical requirements adequately.

From Rebuild, April 1987

Music Technology

Daniel Fournier
Lecturer, Music Technology Division, Queensland Conservatorium of Music George Street, Brisbane

THE MUSIC TECHNOLOGY COURSE

The Diploma of Music (Music Technology) course is, according to the world-wide Directory of Educational Programs published by the Audio Engineering Society of New York, the only tertiary level training course in the Southern Hemisphere being offered to students wishing to become qualified Music Technologists.

THE OBJECTIVES

Graduates from the course will have the musical and technological knowledge and skills required for successful recording, transmission and reproduction of any type of audio programme. They will have the ability to recognize, understand and make use of contemporary technological advances in the audio field and will have an understanding of the relationship between the artistic and the technical aspects of professional music production.

THE AREAS OF STUDY

The course is divided into two major areas. Firstly, an understanding of the technology involved and secondly an understanding of music. Aside from attending lectures on the theoretical aspects of Acoustics, Computer Science, Electronics, Mathematics, Music Technology and Physics, the students spend a major portion of their time (ranging from 130 hours in their first year to 260 hours in their third year) in hands-on experience in our recording complex. They also benefit from individual tuition, group projects, music technology workshops, concert recording classes and work experience programmes. To develop their musical skills and understanding, they study an instrument, the History of Music, the Materials of Music (i.e., the Writing Techniques of Music) and attend Musicianship classes.
The course aims to train students to be responsible for the successful operation (on tape, film and/or disc), transmission (via radio, television and/or sound reinforcement) and reproduction (through loudspeakers and/or headphones) of any type of audio programme, in a field demanding a combination of musical and technological knowledge and skills. The students must therefore become familiar with the problems of musical interpretation as they need to realize the intention of both composers and performers in artistic terms and audio quality.

THE RECORDING COMPLEX

At the Queensland Conservatorium of Music, the recording complex was opened in 1974 and was equipped with 26/16-channel mixing console, a 16-track analogue tape recorder, a 2-track stereophonic mastering tape recorder as well as a wide range of outboard signal-processing equipment. The recording studio itself comprised a control room, a control room annexe and a recording room. In 1984, I re-organized the recording complex and designed a maintenance room and a "live" room permitting recording from the Auditorium (large enough to seat 400 and to stage full opera productions). In 1987, a further two rooms were allocated to the Music Technology School: a lecture room with stereophonic audio-visual facilities and a computer room which accommodates a Fairlight C.M.I. Series 3.

The recording complex is able to produce records on the MUSICON label. In 1981, a record was made of Miss Gillian Weir playing the Conservatorium's Baroque-style pipe organ. In 1982, a record was made of the Conservatorium Singers prior to their international tour. In 1983, Mr. Paul Terracini, the Conservatorium's trumpet lecturer, produced a record, and in 1984 Mr. Stephen Savage, senior lecture in piano, made a recording of Sir Michael Tippett's Sonatas to celebrate his visit to the Conservatorium.

THE EMPLOYMENT

Graduates from the Music Technology course may be employed as Audio Engineers in the areas of music recording, film and video production, radio and television broadcast, and sound reinforcement, working either under specific instruction from a Music Producer who has artistic control over the project or unsupervised, producing a specified result from given raw materials.

The first students to graduate from the Music Technology course did so in 1985 and last year a further four students graduated. They are all employed in the audio and entertainment industries as follows: audio engineers at Audio Workshop (Brisbane), Burbank Productions (Brisbane) and Platinum Australia (Melbourne); an audio operator at Channel 7 (Brisbane); an audio-visual engineer at the Queensland Performing Arts Complex (Brisbane); broadcast officers at the Australian Broadcasting Corporation (Adelaide and Brisbane); a keyboard demonstrator at Palings (Brisbane); a managing director at Winckel Music (Brisbane); a music producer at Studio 21 Rock City (Sydney); and a music consultant at Fairlight Instruments (Sydney).

Noise pollution control in New South Wales

The last 10 years have seen important developments in the control of environmental noise in New South Wales.

The Noise Control Act, which was enacted in 1975, gave the State Pollution Control Commission the task of developing and implementing strategies to control noise from transport, industrial, commercial, recreational and domestic sources. Because of the local nature of many environmental noise problems, some responsibilities were delegated in the legislation to local councils and other State authorities. Local councils are best equipped to resolve domestic noise problems, for example, and the Maritime Services Board deals with noise on waterways.

Traffic noise was one of the first noise problems addressed by the Commission, and the result was the introduction of a regulation to control the use of very noisy cars, trucks and motor bikes. Though they are an important means of noise reduction, noise emission controls on vehicles are only one part of the Commission's comprehensive attack on traffic noise. Other measures being promoted include better house design, the use of noise barriers and planning and development controls.

(Continued p. 50)

(Continued from p. 49)

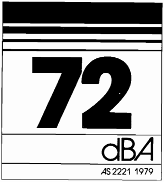
Aircraft noise continues to create significant disturbance to about 80,000 people around Sydney airport. Although the Commonwealth is responsible for airports and aircraft movement controls, the Commission is represented on a committee set up by the Department of Aviation for the development and review of aircraft noise controls, and has endorsed a policy on the siting of dwellings near airports.

Significant progress has been made in controlling noise from industry. Existing noisy industries and new developments have been required to install noise control measures and, as a result, noise levels in many residential areas near factories have been dramatically reduced. Because of the Commission's efforts, approximately 2,500 industries now produce less noise.

The Commission has also introduced noise control regulations to encourage the design of quieter commercial and domestic machines. Residential areas are becoming quieter and better places to live because of these controls.

In many instances, neighbourhood noise problems such as noisy parties, alarms, barking dogs and the like are resolved through negotiation. Officers authorised under the Act usually discuss and find solutions to noise problems before resorting to the full force of the law. Other people use the Government's Community Justice Centres to resolve conflict; about 20 per cent of the issues dealt with by these centres concern neighbourhood noise.

The Commission published a complete guide to environmental noise control called the Environmental Noise Control Manual — the first of its type in Australia. The manual is a guide to policies and procedures for controlling environmental noise, and is used as a reference guide by authorised officers, local government, consultants, developers and Commission staff.



Example of product label showing how much noise various types of equipment produce. Mobile air compressors, pneumatic pavement breakers and air-conditioners must carry noise labels, and labelling will be progressively introduced for lawnmowers, chain saws, garbage compactors and some construction equipment.

Extracted from Environmental Bulletin 3, NSW State Pollution Control Commission

Book Reviews

NOISE POLLUTION

A. Lara Saenz and R. W. B. Stephens (Editors)

John Wiley and Sons, Chichester, 1986, pp. 446. Australian Distributor Jacaranda Wiley, 104a Victoria Road, Gladesville, N.S.W. 2111. Price: A$178.20.

The Scientific Committee on Problems of the Environment (SCOPE) was established by the International Council of Scientific Unions (ICSU) in 1969 in response to the environmental concerns emerging at that time. Included in the mandate of SCOPE is the requirement mandate of SCOPE is the requirement to establish itself as a corpus of informed advice for the benefit of centres of fundamental research and of organisations and agencies operationally engaged in studies of the environment. **Noise Pollution, Effects and Control,** is the 24th publication on behalf of SCOPE and the first to deal exclusively with noise. It is edited by A. Lara Saenz and R. W. B. Stephens and the 18 chapters are contributed by 23 acknowledged experts in their fields. The book is divided into three sections: fundamentals of noise and hearing, effects of noise on man, and sources of noise and its control. There is also an extensive introductory Survey on Noise Pollution by R. W. B. Stephens.

The first section includes chapters on the Physics of Noise (Lara Saenz), Noise Propagation in the Atmosphere (Piercy, Embleton and Sutherland), Acoustic Shielding (Maekawa), Psychophysics of Hearing (Zwicker), Aural Reception (Shaw) and Hearing Mechanisms and Impairment (Evans). The five chapters in the second section include: Auditory After-effects of Noise (Dixon Ward), Non-Auditory Effects (Jansen and Gros), Interference with Aural Communication (Tarnoczy), Noise Pollution at Night (Griefahn), and Hearing Conservation (Glorig). Part three includes: Road Traffic Noise (Lamure), Aircraft Noise (Powers), Solid-borne Noise Control (Heckl), Impact Machinery Noise (Richards), Building Noise Control (Schultz), Noise Pollution Control (Fuchs) and Judicial and Legal Aspects (Aecherli).

In the preface, J. B. Large states that "the book is a true reflection of our current knowledge and indicates how much intellectual effort is now at work to overcome the problems of noise pollution". In general this is a true statement as the material in each section is comprehensive, clearly presented and well referenced. It must be realised that no one book can cover such a vast area — indeed many volumes would be needed. There are some limitations imposed by the particular interests of each of the contributors: for example, in the chapter on road traffic noise there is no reference to the descriptor L10 or to the U.K. Department of the Environment publication "Calculation of Road Traffic Noise" and in the chapter on the legal aspects the only regulations referred to are for Europe and the U.S.A.

For a book covering such a wide range of topics, a good index is essential and the one provided enables the reader to find the relevant sections. This subject index is supplemented with an author index for the references in each section.

In summary, this is a very comprehensive and useful reference book for anyone working in the area of controlling/limiting noise. It does not provide all the answers but gives the supporting details on the needs for control plus guidance on how the control can be achieved, (with case studies where appropriate). It is neither a Handbook, nor an Introductory Book, but does provide a wealth of information and would certainly be a worthwhile addition to any library.

Marion Burgess

Signal Processing III Theories and Applications

Edited by

I. T. Young, R. P. W. Duin, J. Biemond, J. J. Gerbrands

Proceedings of EUSIPCO-86, Third European Signal Processing Conference, The Hague, The Netherlands, 2-5 September 1986.

Published by North Holland (Elsevier Science Publishers) in two parts (1,420 pages).
Price: US$180.00.

It is rather a daunting task to review the proceedings of a comprehensive conference on signal processing since such a wide range of subjects was covered and a reviewer cannot suppose to have expertise covering that wide range, so this review will overview the entire proceedings and consider in a little more detail sections which would probably be of greater interest to readers of Acoustics Australia.

A question that springs to peoples' minds which will be addressed at the start rather than the finish, is whether the publication can be considered as a worthwhile addition to a library. Conference proceedings often turn out to be of little value because the papers are too sketchy or too specialised and there is some of that in these volumes; however, the general impression is that if a worker would like a review of current developments in signal processing with the references in the presented papers acting as a springboard for further study, then these volumes can be recommended.

There are 20 sub-sections in the volumes and to gain some idea of the spread of subjects the titles of the sub-sections will now be simply listed — one-dimensional signal theory; one-dimensional signal processing; one-dimensional filtering; spectral analysis; speech and sound; audio and speech processing; speech coding; speech analysis and recognition; applications; two - dimensional signal processing; image processing; digital audio; image analysis; detection and estimation; communications; radar; geophysics; chips; implementation; biomedical applications.

Some of the subjects covered will now be reviewed in a little more detail. The problem of signals which are not stationary (properties vary with time) was addressed by several authors who considered the use of parametric approaches (autoregressive and associated maximum entropy methods; autoregressive moving average modelling) rather than conventional fourier analysis. Several authors considered the situations of the analysis of signals which were not sampled equidistantly in time. The constraints on the parametric approaches (maximum entropy and maximum likelihood) were considered by several authors.

There is still a great interest in the implementation of adaptive filters as there were many papers on this subject. Speech analysis was an important subject and authors considered a range of subjects, including Rate Distortion Functions (minimum rate of information which has to be transmitted through a communication channel to ensure that the receiver can reconstruct the signal with a distortion not exceeding a prescribed value); reconstruction of missing speech packets; decomposition and modelling of speech; tube models for speech synthesis; and vocal tract models.

Coding for telecommunication is a subject which is occupying the attention of many workers as well as techniques for word recognition. Expert systems are starting to be applied to word recognition using the artificial intelligence language PROLOG. There were a great many papers on image analysis and enhancement which were centred on two-dimensional signal processing. This field is rapidly growing and there were many excellent papers on the work being carried out.

R. W. Harris

DETAILING FOR ACOUSTICS

Peter Lord and Duncan Templeton

Architectural Press, London, 2nd edition, 1986, pp. 205. Review copy from Architect, R.A.I.A. Bookshop, 156 Bouverie Street, Carlton, Vic. 3053. Price: $A61.60 (plus $4.50 for mailing).

This review comprises two parts: the first from Marion Burgess, whose main experience has been in the academic and research areas, and the second from Eric Taylor, who is both architect and acoustic consultant.

This is the second edition of a very practical and useful book. Peter Lord, Professor of Acoustics at Salford University, and Duncan Templeton, a practising architect, are Principals of the Acoustics Unit of the Building Design Partnership which is one of the largest multi-disciplinary practices in the U.K. In their objectives for the book they state that it is "composed largely of guidance details intended for reference by architects, students, structural and service engineers and interior designers". I think that "acoustic consultants" could be added to the list as I am sure everyone can learn something, even if it is just another way of approaching a particular detail.

The main portion of the book is devoted to the clearly drawn details grouped in ten sections: roofs, ceilings, partitions, walls, floors, doors, windows, linings, services and building types. The appendices give brief explanations of the concepts of sound insulation and sound absorption and definitions of the terminology. The book is not designed to be used by someone with no knowledge of acoustics and a rather limited "Guide to Further Reading" is provided.

The construction details are mainly drawn to scale and are complete with specification notes (where relevant) which show how the desired results may be achieved by the correct use of building materials, products and components. Taking as an example the section on windows: the first two pages give the sound insulation data for various thicknesses of glass and glazing arrangements. The next three pages give details of window frames. The last detail in this section is for an observation/studio window and clearly shows the separation of the two frames. This is followed by a page showing sections for various edge seals. A criticism here is that no indication of the relative performance of the different seals is given.

No one book is going to cover all that must be considered when detailing for acoustics is required so there are bound to be some omissions and lack of supportive data (often this may arise because the data is not available). One limitation of the book is that it refers to U.K. products and construction techniques which may need to be modified for Australian conditions.

With these reservations I can recommend this book to all those involved with getting the concepts of good detailing across to students, architects, engineers, etc. — it is wonderful to be able to turn over the pages during a discussion and say "this is the type of detail which could/should be used here".

Marion Burgess

* * *

Fortunately the acoustically uninitiated have progressed somewhat from the days when a door covered in green baize signified that it was supposed to be "soundproof".

But even today many people (and I am ashamed to add that some architects are included in this group) still believe that the application of rockwool or acoustic tile to the face of a wall is the panacea of all acoustical problems, including noise reduction through the wall!

Writing as an architect as well as an acoustical engineer, I have found it disturbing that, until recently, the majority of architects either wouldn't or couldn't recognize the importance of the correct use of materials and detailing in acoustical situations.

The recent trend in building development is that clients are becoming more concerned about good acoustics and brief their architects accordingly. The architect either wisely seeks advice from an acoustical consultant or, unwisely, "does his own thing", sometimes with disappointing and costly results.

I can therefore thoroughly recommend "Detailing for Acoustics" as a must for all architectural offices. It is an excellent reference which can be adapted for most acoustical detailing problems. I would also recommend the book for use by building developers, mechanical engineers and even acoustical engineers. I refer to my copy quite often.

Eric Taylor

SOUND AND STRUCTURAL VIBRATION

Radiation, Transmission and Response

Frank Fahy

Academic Press, London, 1985, 309 pp., ISBN 0-12-247670-0. Price: A$172.

In his Preface, the author states: "In writing this book my aim has been to present a unified qualitative and quantitative account of the physical mechanisms and characteristics of linear interaction between audio-frequency vibrational motion in compressible fluids and structures with which they are in contact. The primary purpose is to instruct the reader in theoretical approaches to the modelling and analysis of interactions, whilst simultaneously providing physical explanations of their dependence upon the parameters of the coupled systems. It is primarily to the engineering student that the book is addressed, in the firm belief that a good engineer remains a student throughout his professional life."

In carrying out these aims the author has placed emphasis on wave aspects throughout so as to include the effects of interference, scattering and diffraction. The first two chapters cover necessary introductory material. Chapter 1, "Waves in Fluids and Solid Structures", gives a clear account of standard theory including some interesting asides and questions for the reader. The author's use of phase diagrams is particularly good and makes clear the knotty subject of phase relations in vibrating bodies that are frequently glossed over in similar texts. Chapter 2, "Sound Radiation by Vibrating Structures", includes a theoretical treatment of a simple source, a baffled piston, plates and shells.

Chapter 3, "Fluid Loading of Vibrating Structures", contains some important material but makes rather dull reading. There seems to be a need for more illustrative material. At this point in the book a summary of concepts and main conclusions would help pave the way for Chapter 4, which is central to the book.

Chapter 4, "Transmission of Sound Through Partitions", contains a thoroughly researched survey of numerous transmission problems. The main conclusions and assessments of each case could have been more clearly set out. The diagrams are outstandingly clear. Some of the sections make turgid reading but by the time the author reaches the section on the mechanical coupling of double partition leaves he is well into his stride, the treatment being enlivened by some excellent diagrams.

Chapter 5, "Acoustically Induced Vibration of Structures", is again mainly concerned with theoretical relationships, some applications are hinted at but relatively few details are supplied.

The book concludes with two further chapters, "Acoustic Coupling Between Structures and Enclosed Volumes of Fluid" and "Introduction to Numerically Based Analyses of Fluid-Structure Interaction", in which useful introductions are given to techniques such as statistical energy analysis, finite element method and integral equation analysis.

Overall the book is neatly produced with a copious supply of excellent diagrams. The reading of some sections is impeded by unrelieved blocks of text or equations. Shorter paragraphs and a greater use of sub-headings would help. The discussion of the meaning of the various terms in important equations is often hidden. The discussion is usually there but frequently buried in a paragraph containing many other points.

A final comment must be made on the price of this book. It is hard to imagine that, for a book of some 300 pages, production costs would have risen so much in recent years that it is necessary to have a price tag of A$172. One can imagine that libraries would purchase the book and, possibly, acoustical consultants whose businesses are in good condition, but it is doubtful if engineering students could afford that sum for a textbook if it were prescribed for their course.

Howard Pollard

Software for Analysis of Acoustic Noise by an IBM PC

Accompanying disc reviewed in volume 15 number 1 of Acoustics Australia. Supplied by M. B. & K. J. Davidson Pty. Ltd., 17 Roberna Street, Moorabbin, Victoria 3189.

The original review of software disc was incomplete due to the lack of supporting documentation; however, the suppliers have since supplied further information and so this review will be considered as an addendum to the original review.

The documentation supplied described only the software for the Leq and this is well written although a little terse in its format. The only problem is that it is written for an ACORN BBC computer and so many of the instructions about formatting disks and connecting peripherals do not apply to an IBM PC. The reference to USER PORT and ANALOG INPUT have no relevance to an IBM PC user. The unit you plug in to do the frontline processing for Leq is a Cirrus CRL 2.22. Perhaps the readers are more aware of model numbers although section 19 of the documentation states that data can be taken from "any DP15 Sound Level Meter or the DP25 CRL 2.39A or ATR11 and 22. Data for the Quest Micro 15 will also be accepted."

No further documentation was supplied on the third octave analyser program.

R. W. Harris

Bradford Expansion

The **Bradford Insulation Group** and **Dulux Australia Limited** have announced Bradford's appointment as National Distributor of the Dulux Foster range of products. Bradford will market and distribute the specialist range of Foster sealants, mastics and adhesives, which are widely used throughout the thermal insulation, airconditioning and foam coating industries.

The agreement will greatly benefit contractors and specifiers in the industry. It adds the distribution and marketing strengths of Bradford Insulation to the proven performance of the Foster Product Range and the quality control and manufacturing skills of Dulux. Emphasis will be placed on product development and the introduction of new products, developed from industry feedback, in the market.

NEW PRODUCTS

Bruel & Kjaer

Phase Matched Microphones

Bruel & Kjaer's Sound Intensity Microphone Pair Type 4181 opens up the way for more accurate sound intensity measurements at low frequencies and in reactive sound fields. The old problem of uncertainty in low-frequency phase matching — caused by the microphone venting system — has been overcome by a new Bruel & Kjaer production technique, now being patented, which consists of a phase corrector unit fitted to the back of the microphone cartridge.

Phase matching is now at a high-precision 0,05° at frequencies below 250 Hz. A calibration chart supplied with each Type 4181 gives the individually measured phase matching between 20 Hz and 5 kHz.

The microphone pair, supplied with individual phase and ampltiude calibration in a box with 12 mm and 50 mm spacers, is now included in the well-known 3519 sound intensity probe to give even better performance and reliability.

Data Logger Module

The BZ 7106 Short Term L_{eq} module is yet another in a series of application modules for the Bruel & Kjaer Modular Precision Sound Level Meter Type 2231.

This module enables the Type 2231 to dump noise data for further processing at user-selectable intervals (as frequently as once per second) on to devices with an RS 232C interface such as data loggers, computers, terminals and high-speed printers.

The module also permits the Type 2231 to function as a Precision Integrating Sound Level Meter in its own right. It is then capable of measuring SPL, L_{eq}, SEL, min. and max. SPL, Peak and Max. Peak Levels.

Frequency Analysis Module

The BZ 7103 Frequency Analysis Module is the latest in a series of Application Modules for the Bruel & Kjaer Modular Precision Sound Level Meter Type 2231. While maintaining the function of the Type 2231 as an integrating Sound Level Meter, the module enables it to make automatic serial frequency analyses by means of the $1/3$- and $1/1$-Octave Filter Set Type 1625.

When Type 2231 is connected to a printer by means of the Interface ZI 9100, the set-up is used to maximum advantage and all parameters and measurement data are conveniently available in the form of hard-copy printouts. The printouts have variable headings and are recorded both digitally and graphically in both full and short form.

The start and stop frequencies are selectable. To optimize the total measurement time, the set-up measures the L_{eq} (average sound pressure level) in each frequency band over a length of time which depends on the filter bandwidth. It is also possible to preset the number and average up to 999 frequency analyses made at the same or different points.

Non-Stationary Signal Analysis

Bruel & Kjaer has introduced a versatile waterfall-display programme for detailed analysis of non-stationary signals. Applications of software package WT 9121 include machine run-ups and coast-downs, reciprocating machine analyses, and order tracking on machines running at variable speeds. The programme is designed for use with Bruel & Kjaer's Dual Signal Analyzers Types 2032 and 2034. The computing speed and the versatility of the IEEE interface of the analyzer are fully utilised to give a fast spectrum transfer rate of up to 20 spectra per second. Spectra up to 800-lines can be transferred.

A high degree of flexibility is also afforded. Spectra can be transferred at selected time intervals, after a selected number of trigger counts, as a function of the operating speed of the machine under investigation, or under manual control. Similarly, a wide range of display options is provided. Measurements can be presented as 3-D plots of up to 100 spectra, as Campbell diagrams, as maximum value at each frequency, or as a plot of the total RMS level of all the spectra in the 3-D plot.

Further information: Bruel & Kjaer Aust., 24 Tepko Road, Terrey Hills, N.S.W. 2084. Telephone (02) 450 2066.

Pulsar

Industrial Noise and Exposure Meter

The Model 85 series of Industrial Sound Level Meters show, directly on scale, both the noise level and its allowable exposure time. The time zones are shown in green, orange and red to indicate safe, intermediate and dangerous areas. A feature of the unit is one single control switch, down for battery check, up for meter. A "30 dB button" is provided on the front of the unit, permitting measurements down to 50 dBA.

An electret condenser microphone is mounted on a telescopic boom to minimise case reflections and ensure measuring accuracy. The 85E meets the requirements of BS 5969 Grade 3, while the Model 85E2 meets BS 5969 Grade 2. It is recommended that a sound level meter should be calibrated before and after each measurement and while all units are available alone, the Model 85/100A kit contains both the sound level meter and Model 100A 2-level calibrator together with windshield, spare batteries and calibration screwdriver in an easily portable, lightweight carrying case.

Further information: Pulsar Instruments, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 OPH, U.K.

New Publications

The following publications have been received by the Society and are held, temporarily, in the Acoustics Laboratory, School of Physics, University of N.S.W. They are available for inspection or loan by members. Photocopies (not in contravention of copyright conditions) may be ordered by contacting Cronulla Secretarial Services on (02) 527 3173. A charge will be made for photocopying and postage.

Guide to Technical Literature

This guide to technical literature, produced by James R. Ramsey, is intended to provide a ready resource to major technical works relating to Architectural, Building and Mechanical Systems Acoustics during the past two decades. It is subdivided into two volumes (each approximately 100 pages); Volume 1 primarily on Applications and Volume 2 on Technology. Within each section the papers and reports are listed under general subject areas and the total number of citations in the two volumes exceed 3,000. It was produced in October 1986 and is aimed at assisting those doing literature searches. The cost for Volume 1 is $US28 and Volume 2 $US25, while the combined set is $US45.

Further details: R/T Books, James R. Ramsey, Technical Consultant, P.O. Box 1833, 2907 Holly Place, La Crosse, W1 54602-1833, U.S.A.

KH Stramit Literature

KH Stramit, a Sustaining Member of the Society, has announced its new range of technical literature. This literature will include all the latest research and development plus technical information on the wide range of products.

Further information: Frank Collett, National Sales Manager, 52 Mandoon Road, Girraween, N.S.W. 2145.

Inter-Noise 86 Proceedings

Inter-Noise 86 was held at M.I.T. in July 1986 and attended by 525 delegates from 36 different countries. The Proceedings from this Conference are now available.

The two-volume set comprises 271 papers covering all areas of noise control engineering, including aircraft noise, road traffic noise, machinery noise reduction, sound intensity measurement techniques, noise control instrumentation and noise regulations. The cost for the set is $US75, with additional $US30 for overseas airmail. Payments must be made in U.S. funds on a U.S. bank.

Further information: Noise Control Foundation, P.O. Box 2469, Arlington Branch, Poughkeepsie, N.Y. 12603, U.S.A.

Butterworth Technical Dictionaries

Specialist dictionaries are available from Butterworths Pty. Ltd., 271 Lane Cove Road, North Ryde, NSW 2113, (02) 887 3444, on a variety of topics, including: Audio, Radio & Video; Audio-Visual Terms; Data Processing; Electrical Engineering; Electrical, Electronics & Computer Abbreviations; Electronics; Energy Technology; Mechanical Engineering; Medical.

Bruel & Kjaer Literature

The following literature has recently been released by Bruel & Kjaer.

Three New Applications Notes on Dual Channel Analyzers, 2032 and 2034

Time Windows provides a clear explanation for non-specialists of the theory behind the window functions on the Type 2032 and the Type 2034. In a section on practical applications, the choice of the appropriate window for each signal is made plain.

The scaling of spectra on FFT analyzers is often a source of misunderstanding. For a clarification, read *Choose Your Units!* The application note describes how the correct units are matched to a given signal.

The Hilbert Transform — a mystery to many users — is built into the Type 2032 and the Type 2034. The third application note, *Practical Use of the Hilbert Transform*, strips away the question marks which often surround this extremely useful feature. Furthermore, it outlines a number of practical applications.

Brochure for Noise Generators, 1049 and 1051

The six-page brochure, *The New Gold Standard*, provides a full description of these microprocessor-based, ATE type instruments which integrate the need for high signal purity and accuracy with ease of use and extreme versatility.

Brochure for Dual Channel Analyzers, 2032 and 2034

A 32-page brochure entitled *A World of Applications — Dual Channel Analyzers Types 2032 and 2034*, outlines 12 application areas where a Bruel & Kjaer Dual Channel Analyzer can be used first to identify and then to assist in providing solutions for engineering problems. It is aimed principally at the multi-faceted modern engineering industry.

In the field of vibration, application areas include mobility measurements, modal testing and machine-health monitoring. In the area of acoustics, the brochure covers architectural acoustics and sound intensity measurements, while in electroacoustics there is a review of transducer measurements and sound reinforcement systems. Other topics include the analysis of servo-systems, and materials testing. Finally, there is an outline of the many ways in which Bruel & Kjaer Dual Channel Analyzers can make a useful contribution to university and college courses.

Further details: Bruel & Kjaer Aust., P.O. Box 177, Terrey Hills, N.S.W. 2084.

JOURNALS

Acta Acustica

Vol. 12 No. 1 (1987)

Applied Acoustics

Vol. 21 No. 1 (1987)

Contents include: **W. A. Davern**, Measurement of low frequency absorption; **L. C. Fothergill & J. E. Savage**, Reduction of noise nuisance caused by banging doors; **S. J. Bowles & E. Gold**, Development of a rating procedure for impact noise transmission through walls.

Vol. 21 No. 2 (1987)

Special issue on road traffic noise.

Vol. 21 No. 3 (1987)
Contents include: **J. G. Charles, J. Miller & H. Gwatkin,** Assisting the assisted resonance at the Central Hall, York, UK; **C. H. Chew,** Acoustical properties of coal.

Archives of Acoustics

Vol. 11 No. 1 (1986)
Contents include: **A. Rakowski & A. Jaroszewski,** Reaction delay time in the process of detection and discrimination of acoustic signals; **G. Budzynski,** Theory of the reflective localisation of sound sources; **M. Hagel,** Method of calculating the acoustical wave reflection coefficient from a not-sharp boundary of two media.

Canadian Acoustics

Vol. 15 No. 1 (1987)
Contents: **E. Rebke,** The effect of various placements and densities on the sound absorption of baffles; **S. M. Abel,** Noise-induced hearing loss and hearing protection; **R. Hetu, R. Phaneuf & C. Marien,** Non-acoustic environment factor influences on occupational hearing impairment.

Chinese Journal of Acoustics

(in English)

Vol. 5 No. 4 (1986)
Contents include: **T. Duchun,** Computer simulation of noise processes; **C. Tong & Z. Darui,** Acoustical properties of the Yongle Bell; **M. Bergmen,** Populations with special auditory problems in large areas.

Vol. 6 No. 1 (1987)
Contents include: **Z. Zhichi, L. Peizi & W. Zhiguo,** Numerical solutions compared with experimental results for sound propagation in ducts; **W. Chenhao,** Principle of piezoelectric damping of vibration — an experimental investigation; **L. Shaoquan & C. Zhongyi,** A new cepstrum technique for cancelling the effects of sound reflection; **T. Jing & S. Jiazheng,** A study of spatial active noise attenuations.

JAAMIM

Vol. 6 No. 1 (1987)

J. Catgut Acoustical Society

No. 47 (May 1987)
Contents include: **C. Rubin & D. F. Farrar,** Finite element modelling of violin plate vibrational characteristics; **I. Firth,** Construction & performance of commercial quality violin strings; **S. M. Marty,** Assessment of innovations in the construction of the classical guitar; **N. C. Pickering,** A musician's spectrum analyser for violins.

REPORTS

Royal Institute of Technology, Stockholm

Speech Transmission Laboratory.
Quarterly Progress and Research Report 4/1986.
Speech research summary report, April 1987.

Institute of Sound & Vibration Research

Technical Report No. 138, 77 pp.
B. W. Lawton & D. W. Robinson
An investigation of tests of susceptibility to noise-induced hearing loss.

Technical Report No. 139, 60 pp.
R. C. N. Leung
Wave propagation through right-angled joints with compliance.

Technical Report No. 140, 76 pp.
J. M. Mason & F. J. Fahy
The use of acoustically tuned resonators to improve the sound transmission loss of double panel partitions.

Technical Report No. 141, 88 pp.
R. J. Pinnington & L. C. Chow
On the prediction of the loss factors of plates using sand granular material.

Technical Report No. 142, 42 pp.
J. J. Kelly
Acoustic mode coupling in a circular-section duct containing a concentric porous windscreen.

Publications by Australians

We are grateful to Richard Rosenberger, University of NSW, for this updating of publications by Australian authors. Within each year the listing is alphabetical by first author.

Reaction to Aircraft Noise in Residential Areas Around Australian Airports.
R. B. BULLEN, A. J. HEDE,
E. KYRIACOS.
National Acoustic Laboratories, Greville Street, Chatswood West, NSW 2067.
J. Sound Vib. **108 (2),** 199-225 (1986).

Comparison of the Effectiveness of Measures of Aircraft Noise Exposure by Using Social Survey Data.
R. B. BULLEN, A. J. HEDE.
National Acoustic Laboratories, Greville Street, Chatswood West, NSW 2067.
J. Sound. Vib. **108 (2),** 227-245 (1986).

LASER-Doppler Measurement of Complex Acoustic Impedance.
(1) M. R. DAVIS.
(2) K. J. HEWS-TAYLOR.
(1) Dept. of Civil and Mech. Eng., University of Tasmania, GPO Box 252C, Hobart, Tasmania 7001.
(2) CSIRO Divn. of Appl. Phys., Lindfield, NSW 2070.
J. Sound Vib. **107 (3),** 451-470 (1986).

The Ensemble Variance of Random Noise in a Reverberation Room.
J. L. DAVY.
Division of Building Research, CSIRO, Melbourne, Vic.
J. Sound. Vib. **107 (3),** 361-373 (1986).

Creeping Wave Analysis of Impulse Propagation Through a Shadow Boundary.
C. G. DON, A. J. CRAMOND.
Dept. of Appl. Physics, Chisholm Inst. of Techn., 900 Dandenong Road, Caulfield East, Vic. 3145.
J. Acoust. Soc. Am. **80 (1),** 302-5 (1986).

Calculation of Acoustic Impedance of Multi-Layer Absorbers.
I. P. DUNN, W. A. DAVERN.
Div. of Bldg. Res., CSIRO, PO Box 56, Highett, Melbourne, Vic. 3190.
Appl. Ac. **19 (5),** 321-334 (1986).

The Effect of Bandwidth on the Performance of a Postbeamformer Interference Canceller.
(1) L. C. GODARA.
(2) A. CANTONI.
(1) School of Appl. Sc., Canberra College of Advanced Education, PO Box 1, Belconnen, ACT 2616.
J. Acoust. Soc. Am. **80 (3),** 794-803 (1986).

Harmonic Frequency Spectra of Vibrating Stepped Strings.
H. P. W. GOTTLIEB.
School of Science, Griffith University, Nathan, Qld. 4111.
J. Sound. Vib. **108 (1),** 63-72 (1986).

Addendum to "Harmonic Frequency Spectra of Vibrating Stepped Strings".
H. P. W. GOTTLIEB.
School of Science, Griffith University, Nathan, Qld. 4111.
J. Sound. Vib. **108 (2),** 345 (1986).

New Types of Vibration Modes for Stepped Membranes.
H. P. W. GOTTLIEB.
School of Science, Griffith University, Nathan, Qld. 4111.
J. Sound. Vib. **110 (3),** 395-411 (1986).

Vibration Characteristics of a Beam with Sliding End.
H. P. W. GOTTLIEB.
School of Science, Griffith University, Nathan, Qld. 4111.
Appl. Ac. **19 (5),** 347-356 (1986).

Determination of the Natural Frequencies of Transverse Vibration for Conveyor Belts with Orthotropic Properties.
A. HARRISON.
Division of Appl. Physics, CSIRO, Sydney, NSW 2070.
J. Sound. Vib. **110 (3),** 483-493 (1986).

Is a Full Nonlinear Method Necessary for the Prediction of Radiated Engine Exhaust Noise?
(1) A. D. JONES.
(2) W. K. van MOORHEM,
R. T. VOLAND.
(1) National Exhaust Ind. P/L., 29 Morrow Rd., O'Sullivan Beach, SA 5166.
Noise Control Eng. J. **26 (2),** 74-80 (1986).

Loudness Summation, Masking, and Temporal Interaction for Sensations Produced by Electric Stimulation of Two Sites in the Human Cochlea.
Y. C. TONG, G. M. CLARK.
Dept. of Otolaryngology, University of Melbourne, Parkville, Vic. 3052.
J. Acoust. Soc. Am. **79 (6),** 1958-1966 (1986).

Point Mobility Techniques for the In Situ Estimation of Modal Densities of Coupled Cylindrical Shells.
M. P. NORTON, D. RONOWSKI.
Dept. of Mech. Eng., University of WA, Nedlands, WA 6009.
Appl. Ac. **19 (5),** 383-396 (1986).

FUTURE EVENTS —

● Indicates an Australian Conference

1987

August 23-26, ILLINOIS
INTERNATIONAL COMPUTER MUSIC CONFERENCE.
Details: University of Illinois, Room 247 Administration Building, 506 S. Wright St., Urbana, Illinois, 61801, U.S.A.

August 24-28, U.S.S.R.
11th INTER. SYMPOSIUM ON NON-LINEAR ACOUSTICS
Details: V. K. Kedrinskii, Lavrentyev Institute of Hydrodynamics, Lavrentyev Prospekt 15, 630090 Novosibirsk.

September 8-11, POLAND
XXXIV OPEN SEMINAR ON ACOUSTICS
Details: Inst. of Telecommunication & Acoustics, Wroclaw Techn. Univ., Wybrzeze Wyspianskiego 27, 50-370 Wroclaw.

September 13-16, BIRMINGHAM
CONFERENCE OF BRITISH SOCIETY OF AUDIOLOGY
"Aspects and Implications of Hearing Impairment Throughout Life."
Details: Mr. N. Bland, Centre for the Hearing Impaired, Western Road, Birmingham, B16 7QQ, U.K.

September 15-17, CHINA
INTER-NOISE 87
"Noise Control in Industry".
Details: Inter-Noise 87, 5 Zhonggvancun St., P.O. Box 2712, Beijing, China.

September 22-25, WARWICK
NEW MATERIALS AND THEIR APPLICATIONS
Details: Meetings Officer, Institute of Physics, Belgrave Square 47, London SW1X 8QX, U.K.

October 5-9, CZECHOSLOVAKIA
NOISE AND ENVIRONMENT
Details: Dom Techniky Csvts, Secretariat 26, Akustickej Konferencie, Skultetyho, ul 1, 832 27 Bratislava, Czechoslovakia.

November 5-8, LAKES DISTRICT
REPRODUCED SOUND 3.
In collaboration with Audio Eng Soc, Assoc Sound & Communic Eng, Electro-Acoustic Music Assoc and Assoc Prof Recording Studios.
Details: Institute of Acoustics, 25 Chambers Street, Edinburgh, EH1 1HU, U.K.

● November 12-13, HOBART
ACOUSTICS IN THE EIGHTIES.
Details: Stephen Samuels, A.A.R.B., P.O. Box 156 (Bag 4), Nunawading, Vic., 3131.

November 16-20, MIAMI
MEETING OF ACOUSTICAL SOCIETY OF AMERICA
Details: Mrs. B. Goodfrend, A.S.A., 335 East 45th St., New York, NY 10017, U.S.A.

November 26-29, LAKES DISTRICT
IOA AUTUMN CONFERENCE — INDUSTRIAL NOISE.
Details: Institute of Acoustics, 25 Chambers Street, Edinburgh, EH1 1HU, U.K.

● December 1-4, LAUNCESTON
8th AUSTRALASIAN CONFERENCE ON COASTAL AND OCEAN ENGINEERING.
Details: Conference Manager, Institution of Engineers, 11 National Circuit, Barton, ACT, 2600.

December 17-18, NORWICH
UNDERWATER COMMUNICATION AND POSITION FIXING.
Details: Dr. R. Coates, School of Information Systems, University of East Anglia, Norwich NR4 7TJ, England.

1988

● January 25-29, SYDNEY
BICENTENARY CONGRESS OF PHYSICISTS
Details: Dr. Collocott, CSIRO Division of Applied Physics, P.O. Box 218, Lindfield 2070.

● February 16-24, CANBERRA
REMOTE SENSING OF THE ATMOSPHERE AND OCEANS.
Details: Sec. for Remote Sensing Conference, Physics Department, University College, Australian Defence Force Academy, Campbell, A.C.T. 2600.

February/March, MODENA
URBAN NOISE AND TERRITORIAL ADMINISTRATION.
Details: Prof. P. Zaniol, PMP-Settore Fisico Ambientale, USL n16, c/- Policlinico, Via del Pozzo 71, 41100 Modena, Italy.

March 15-17, GERMANY
DAGA '88
Details: R. Martin, Abt. 1-Mechanik and Akustik, Bundesalle 100, D-3300 Braunschweig.

May 16-20, SEATTLE
MEETING OF ACOUSTICAL SOCIETY OF AMERICA
Details: Mrs. B. Goodfriend, A.S.A., 335 East 45th St., New York, NY 10017, U.S.A.

June 6-10, YUGOSLAVIA
XXXII ETAN CONFERENCE
Details: Prof. P. Pravica, Electrotechnical Faculty, Bulevar Revoluci je 73, YU-11000 Belgrade.

August 21-25, STOCKHOLM
5th INTER. CONGRESS ON NOISE AS A PUBLIC HEALTH PROBLEM
Details: Noise '88, C/- Reso Congress Service, S-113 92 Stockholm.

August 29 - September 1, EDINBURGH
7th FASE SYMPOSIUM ON SPEECH
Details: Mrs. C. Mackenzie, I.O. Acoustics, 25 Chambers St., Edinburgh, EH1 1HU, Scotland.

August 29 - September 1, AVIGNON
INTER-NOISE 88.
"Sources of Noise."
Details: Inter-Noise 88 Secretariat, BP 23, 60302, Senlis Cedex, France.

October 3-5, CHICAGO
IEEE ULTRASONICS SYMPOSIUM
Details: Institute of Electrical and Electronics Engineers, 345 E 47th Street, New York, NY 10017, U.S.A.

October 17-19, MANNHEIM
VDE-KONGRESS 88
Details: VDE-Zentralstelle Tagungen, Stresemannallee 15, D-6000, Frankfurt 70.

November 14-18, HONOLULU
2nd JOINT MEETING OF ACOUSTICAL SOCIETIES OF AMERICA AND JAPAN
Details: Ms B. Goodfriend, A.S.A., 335 E 45th Street, New York, NY 10017, U.S.A.

November 14-17, KOBE
9th INTERNATIONAL ACOUSTIC EMISSION SYMPOSIUM
Details: Prof. Dr. I. Kimpara, Dept. Naval Architecture, Faculty of Eng., University of Tokyo, 3-1, Hongo-7, Bunkyo-ku, TOKYO 113, JAPAN.

1989

May 22-26, SYRACUSE
MEETING OF ACOUSTICAL SOCIETY OF AMERICA
Details: Mrs. B. Goodfriend, A.S.A., 335 East 45th St., New York, NY 10017, U.S.A.

August 24-31, BELGRADE
13th ICA AND SYMPOSIA ON SEA ACOUSTICS AND ELECTRO-ACOUSTICS
Details: 13 ICA Secretariat, Sava Centre, 11070 Belgrade, Yugoslavia.

November 6-10, ST LOUIS
MEETING OF ACOUSTICAL SOCIETY OF AMERICA
Details: Mrs. B. Goodfriend, A.S.A., 335 East 45th St., New York, NY 10017, U.S.A.

1990

May 21-25, PENNSYLVANIA
MEETING OF ACOUSTICAL SOCIETY OF AMERICA
Details: Mrs. B. Goodfriend, A.S.A., 335 East 45th Street, New York, NY 10017, U.S.A.

November 26-30, SAN DIEGO
MEETING OF ACOUSTICAL SOCIETY OF AMERICA
Details: Mrs. B. Goodfriend, A.S.A., 335 East 45th Street, New York, NY 10017, U.S.A.

AUSTRALIAN ACOUSTICAL SOCIETY

1987 ANNUAL CONFERENCE

ACOUSTICS IN THE EIGHTIES

HOBART — 12-13 NOVEMBER 1987

Venue: Physics Department, University of Tasmania, Hobart, Tasmania.

Guest Speakers: Hon. Peter Hodgeman, Tasmanian Minister for the Environment.

Mr. Trevor Brown, Tasmanian Director of Environmental Control.

Sessions: The Conference has no specific theme in order to encourage wide participation. Approximately 30 papers will be delivered and the Sessions will cover acoustic measurement technology, outdoor sound propagation, architectural acoustics, the creation and response to music, road traffic noise, aircraft noise, community noise and noise associated with mining operations.

Technical Exhibition: An exhibition of acoustical equipment, instrumentation, products and literature will be held conjointly with the Conference.

Workshop: A special feature of the Conference will be a Workshop on the future of Acoustics research and education in Australia.

Tours: Both technical and social tours will be conducted during the Conference.

Sponsorship: Commercial sponsorships of the Conference are available and any enquiries would be welcome.

Further Information: Mr. Stephen Samuels, Conference Convenor
C/- Australian Road Research Board
PO Box 156, Nunawading, Vic. 3131