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AUSTRALASIAN ASSOCIATION FOR ENGINEERING EDUCATION

NEWSLETTER

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The Federal Coalition now focuses on science, technology and engineering. On Wednesday, 27 April 1994, Monash University hosted Leader of the Opposition and Shadow Prime Minister, Hon. Dr John Hewson, accompanied by his colleague, the Shadow Minister for Science, Technology and Export Development, Dr David Kemp. Dr Hewson presented an address to staff and students entitled Coalition Focus on Science and Technology *(included in this issue). The picture above shows Dr Hewson presenting his address. Seated are Dr Kemp (r) and Professor Brian Cherry of Monash University Engineering (partly obscured).*

1995 INTERNATIONAL CONGRESS OF ENGINEERING DEANS AND INDUSTRY LEADERS

3-6 July 1995
Melbourne, Victoria, Australia

THE CONGRESS

This Congress is being held to maintain the progress on issues concerning engineering education on a worldwide basis. It is arranged as a follow up to the previous extremely successful International Symposia and Congresses for Engineering Deans and Industry Leaders at Ohio State University in 1989 and at UNESCO Headquarters in 1991. The 1993 Congress was held at UNESCO and was organised by UNESCO and UATI, with appropriate engineering education groups, including the Australasian Association for Engineering Education. These meetings were intended to assist technological development in developing countries by improving engineering education there with the help of institutions in developed countries. They resulted in the development of an action-oriented agenda of specific projects.

The Congress is hosted and organised by the UNESCO Supported International Centre for Engineering Education within Monash University, and is sponsored by The Institution of Engineers, Australia, with other organisations as co-sponsors.

AIMS AND OBJECTIVES

The aim of this Congress is to provide an international forum to continue the dialogue on the effectiveness of methods of adapting engineering education and research to the needs of national and international economies and cultures, and the development of international collaboration. The Congress aims to encourage and stimulate academia/industry co-operation with particular emphasis on developing countries and countries evolving towards a market economy.

CONGRESS THEMES AND TOPICS

The Congress streams will consider themes included in the action-oriented agenda determined in previous congresses. However, other important issues of concern will be addressed. Suggested topics for Congress papers include, but are not limited to, the following areas:

- Sister University programs
- Industry-university interaction
- Database on engineering education
- Transfer of information on engineering education and industrial training
- Completion of education of faculty at engineering schools in developing countries
- Curriculum development and curricular standards in engineering education
- Application of new media in engineering education and industrial training
- Effective methodologies in engineering education and industrial training
- Application of satellite technology in engineering education and distance education
- Recognition of foreign qualifications and accreditation systems for engineering courses
- Management of academic institutions and engineering faculties
- Participation of women and minorities in engineering and engineering education
- Community relationships with engineering and engineering education
- Education for the protection of the environment; sustainable development
- Professional development; promotion of continuing engineering education and industrial involvement
- Co-operation between Engineering Deans and Industry Leaders
- Technology linkages between developed and developing countries

ENQUIRIES

All correspondence relating to the Congress academic program and proposals for papers should be addressed to the General Chairman:

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The Institution of Engineers, Australia

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UNESCO

FROM THE PRESIDENT

Universities are publicly funded, through an efficient federal bureaucracy known as the Department of Employment, Education and Training (DEET). It is worthwhile remembering, however, that universities are set up under Acts of State parliaments, since education, under the constitution, is a state matter. In recent years, the federal bureaucracy has been quite interventionist in the affairs of *autonomous* universities, for the most part with beneficial results.

Australian academia again has seen a new sensation, that is the recent exercise on the ranking of academic institutions in Australia. This unfortunate process may have tremendous implications for the future of university education here and the image of Australian education institutions abroad. After all, we are selling education to a number of overseas countries and earn a substancial revenue for it. It is our belief that the consequences of this exercise are yet to emerge and they may affect Australian universities for the next 20 years.

Several members of our Association have expressed their concern about this attempt to undermine the unity of engineering education so painfully established in recent years. Our expanding membership base, and indeed the Association activities, have proved that the desire for improvement in the struggle to do research and to educate a new generation of engineers is widespread among engineering educators. Our successful AAEE conferences have established a dialogue and collaboration between academics from the so called *old* institutions and their colleagues from the *new* academic establishments. They have seen mutual acceptance, respect and equal partnership being developed. The AAEE can really claim to have played a special role in the process of amalgamation and integration of university engineering education, and we wish to reiterate our commitment to strengthening this process further.

The selection of one university per state to be placed in the first band of the Quality Review is obviously a political convenience. As a matter of curiosity, we would be delighted to know what would be the probability of such an event occurring. Perhaps our AAEE members who are good in probability theory will provide us with an answer. Many fine engineering schools are found in second and lower ranked institutions. The damage that this may do to staff morale in engineering schools is regretted. No doubt this same problem exists in other discipline areas, leading to the conclusion that the process is too crude or the *mesh* too coarse. Discipline reviews would be more appropriate.

This extremely poor public relations exercise has caused unnecessary emotions and raised many questions among the academic community as to the validity of such assessments. Peer review is a good way of making some comparisons, but one must be cautious in drawing firm conclusions which in the end may only divide the community and may not serve the main purpose. This is more so when university images and their limited budgets are at stake. Legitimate questions will always be raised when a member of one academic institution, representing the same community, assesses other universities, especially when his or her university ends up being in the top rank.

We believe that our members fully support the measurement of the status and quality of engineering education, provided that this is based on measurable factors, and that such a measurement is done with full objectivity and scientific rigour. The universities involved, and indeed their academic staff, must possess a full knowledge of the criteria of such an assessment. In addition the procedure should involve more than a short visit to a university. The accreditation procedures of the Institution of Engineers, Australia, are probably a good and constructive model.

I believe that it would have been more appropriate to establish an independent committee, consisting of members drawn from top overseas academic institutions. This would also have provided the Australian academic community with an independent view on how our

institutions stand among international colleagues. We believe that AAEE members would not have been afraid to go through such a scrutiny and would definitely support this sort of assessment.

One way and another, Australian engineering schools are among the most scrutinised higher education units in the world, with IEAust accreditations, Williams Review, external advisors, research proposals, etc. It is a pity they were lumped with other faculties in university wide quality ranking.

Professor Peter LeP Darvall
Deputy Vice-Chancellor
Monash University
President of AAEE

DEATH OF PROFESSOR TOM FINK

Late Prof. Tom Fink at the AAEE Conference.

The Association notes with sadness the recent passing in Sydney of one of its stalwart supporters. Professor Tom Fink was amongst the original group of members of AAEE, contributed a keynote address at our first annual convention and published in the Association's Journal. His early support of the newly created Association was most valued as was his continuing interest and encouragement.

Tom brought to that encouragement an enormous depth of experience and wisdom built up over a varied and outstanding career. He graduated in Mechanical Engineering from The University of Sydney and his career took him to the Imperial College in London before his return to The University of Sydney. There he became Professor of Mechanical Engineering, Dean of the Faculty of Engineering and also Fellow of the University Senate from 1964 to 1967. He moved to the University of New South Wales where he was also Professor and became Dean. In 1978 he took up the position as Chief Defence Scientist in Canberra until his retirement in 1986. He remained an Honorary Visiting Professor at the University of NSW as well as contributing in many ways to the technological advancement of Australia, either as adviser to government or as Executive Director of the Australian Maritime Engineering CRC.

Along the way, Tom had a hand in many interesting projects including adviser to Donald Campbell's Bluebird team in the 1950s and Ken Warby's *Spirit of Australia* hydroplane project. His research found application in the development of the Concorde plane.

Tom received wide and earned recognition for his work, including four Medals as well as the titles of AO, CB and CBE.

The Association will miss his humour and good counsel. It sends its condolences to his family.

Professor Trevor W. Cole
Department of Electrical Engineering
The University of Sydney
Past President of AAEE

COALITION FOCUS ON SCIENCE AND TECHNOLOGY

I am delighted to be here among the practitioners of science as well as its advocates and students. In a very real sense, science and technology are at the very core of our shared future together. Indeed, if Australia is to reach its full potential as a nation, then it is essential that science and technology, and excellence therein, be given their rightful place in Australian society.

We should not just talk about being a clever country - we must be one!

For too long many in the community have been blinded by science and its potential. I believe now is the time that we work to open their eyes to the wonderful opportunities that an enhanced science and technology sector can provide for us all. Our challenge is to make science and technology *come alive* for Australians thereby realising our full potential in science and dramatically improving the lives of all Australians.

Today I would like to concentrate on what ought to be the place of science and technology in Australia's future; the current state of play; and what must be done if Australia is to derive maximum benefit from the extraordinary talent of its scientists and engineers. Actions speak louder than words. The complete absence of any vision or strategy for science and technology after 11 years of this government conveys a message of its own which can be read only too easily. The Keating government simply does not think strategically - it does not formulate long term strategies in science or anything else. The Prime Minister has made no known statement about science in Australia's future. Quite simply, science is not a priority in the Keating republic. It trails a long way behind such fashionable priorities as constitutional upheaval, cutting back the power of the Senate, enhancing the position of the ACTU, and responding to every organised lobby that comes along.

As a result Australia has fallen into what might be called *a dependant country syndrome* as far as science and technology are concerned. These days it is far too easy for people to think that technology is something we get from overseas, and that whatever we do in this country, Australia will be swept up in a technological revolution powered from Japan or the United States. That all we have to do is to gratefully receive what the rest of the world chooses to bestow on us. There is perhaps a view that all we need are the lawyers to regulate it and the accountants to make sure we can pay for it, and that we will have all that is necessary for *the good life*.

Nothing could be further from the truth.

A nation that does not value its scientists and its engineers, that does not have its share of the world's best, will soon find that it is unable to be an effective part of the scientific and technological revolution which is changing the world. We would soon find that we are slipping further behind nations to whom we used to give aid because of their poverty, but whose standard of living and economic strength is now coming to surpass our own. The truth is that in the years and decades ahead, a nation's competitive advantage will depend to a large extent on the quality of its education and its science. And it will equally depend on its capacity to convert the skills and knowledge of its people into useable technology geared to the needs and wants of people throughout the world. Embarrassingly, this is much better recognised by most of the emerging *tigers* of our region. A recent study by UNESCO found that the science and technology effort of countries such as Singapore, South Korea and Taiwan now surpassed that of Australia. In a real sense and despite our past achievements Australia is already falling behind.

Those responsible for our present situation and who therefore attempt to defend it quote figures to show that Australia, particularly Australian industry, is doing better than it was a decade ago in its research and development performance. But the comparison is misguided.

The only thing that matters in today's world is whether we are doing better or worse than our main international competitors, and the answer to that question is that we are doing worse. Too much Australian technology goes overseas because it cannot be developed adequately here.

The Black Box recorder which is now installed in nearly every aircraft in the world was first developed in Australia, but Australian companies could see little benefit in its further development and it was a British company which finally capitalised on the development. A major medical discovery by Professor Don Metcalf at the Walter and Eliza Hall Institute which stimulates the growth of white blood cells as an adjunct treatment for many forms of cancer is currently being developed by two companies - one Japanese and one American, and has sales of over $1 billion a year. A discovery by Dr Michael Waters concerning growth hormones, with enormous potential in medicine and farming, was developed by an American biotechnology company.

Equally, our capacity to utilise and further develop technology originating overseas is much more limited than it should be. Too many of the best and brightest of our young people are part of a continuing *brain drain* to the United States, Canada, Britain and Europe. This is so because they find they are valued much more highly, and can look forward to better careers in those countries than in their homeland. Evidence abounds where outstanding Australians are leading the world in the scientific field. It is an Australian, Dr Hugh Niall, who heads Genentech, the most prestigious bio-technology company in the world. Professor David Buckingham, a chemist of world class distinction at Oxford, and others show what Australians can do.

Australians are outstandingly good at science and Australian engineers have many world class achievements to their credit. There is something in the individualist, no nonsense Australian character that is particularly suited to science, based, as it is, on the relentless search for truth. Australian graduate students are readier to question their professors than are students in more traditional cultures. At a recent conference in Europe one observer noted that all the questions were asked by scientists who were Australian or had been trained in Australia. Over the years, Australia has made a disproportionate contribution to world science. At the same time, however, business investment in research and development in Australia has been near the bottom of the industrialised world. In the most recent figures, Australia stands at 17th out of 24 OECD countries, and that relative ranking has not improved in a decade. Indeed, we have fallen further behind the most dynamic countries in our region, and elsewhere.

How can that be?

How can it be - in a region of the world crying out for scientific and technological skills - that when last year's Australian school leavers stated their preferences for university courses, so few of the highest achievers, and so few absolutely, put themselves down for courses in engineering and science? Why is it - as a report to the Science Council showed - that in Japan, Germany or the US engineering graduates outnumber science graduates by between 2 and 5 to one, and humanities graduates by 1 to 3, whereas in Australia there is only one graduate engineer for every 3 science graduates and for every 5 humanities graduates? That report showed that *particularly in manufacturing industry (Australia) has a much lower proportion of engineers employed than our trading partners, while a far smaller proportion of our university graduates are engineers compared with the dynamo industrial countries.*

These comparisons are but the symptoms of deep seated structural differences - which have come to be cultural differences - which have grown up over many decades in Australia. And they have been encouraged by policies which fostered an inward looking attitude focused on a protected domestic market. These structural characteristics and cultural attitudes, if not adequately addressed by policy, will continue to deny opportunities to young Australian scientists, engineers and technologists. And they will continue to handicap this country in the

increasingly tough and competitive world marketplace.

Mining and agriculture, focused as they have been on the international marketplace, have long recognised the importance of research and development. What is crucial is the spread of this perception to the industries which can add value to our basic strengths. Eighty to ninety percent of Australian manufacturing does not export, and only a relatively small minority have availed themselves of the assistance which is available through schemes such as the 150 per cent tax deduction. The evidence is that this deduction has generally had positive spin-offs which justify its existence in economic terms, but the number of consistent R&D performers has not increased during its life.

We need as a nation both to change attitudes to the importance of staying at the forefront of technology to remain competitive, and more especially, to grow large numbers of new enterprises. It is important to recognise that while only 230,000 new net jobs were created for the private sector in 1987-1992, 300,000 new net jobs were created in smaller to medium-sized companies. Sixty per cent by value of Australia's high valued-added exports are produced by such companies. Young Australians need to know that this country values science and engineering as careers, that it accords them status and gives them appropriate reward. Too many do not sufficiently perceive that this is the case at the present time.

It is a key task of national leadership to make possible an accurate and very different perception. This is not occurring at present. Indeed, in too many respects the opposite is the case, and a message is being given that the institutions which educate, train and employ Australia's researchers and technologists are low down on the list of national priorities and that other - political - agendas dominate the thinking of government and the pressures to which it responds.

Last year the Business Council of Australia published the report of its Innovation Study Commission headed by Sir Roderick Carnegie. The main message of that report was that Australian industry must have the flexibility to innovate, not only with new technology, but with production, design and supply systems as well. Sir Roderick and his colleagues concluded that huge gains in productivity, up to 25 per cent or more, were possible if the policies currently placing Australian industry in a straight jacket, and sapping its capacity to innovate, were removed. It is these policies - the system of business taxation, of business regulation, and above all, of an outdated and excessively rigid labour market - which are robbing industry of the flexibility it could have, and which it needs in order to be internationally competitive. It is, of course, the structure of power in the present government, so visible in the debate between the ACTU and the government over Laurie Brereton's industrial relations legislation, that prevents the essential reforms being introduced.

The development of productive and innovative workplaces lags far behind the preservation of the position of the government's Accord partners as a national priority. Without significant reform, business investment will continue to be held back. Australian industry will be unable to respond to the regional and wider competitive challenges which it faces. The problem extends, however, well beyond the set of policies obviously impeding innovation in the small and medium sized enterprises. The foundations of a world class scientific and technological effort are built in the nation's schools. This is well recognised, for example, by the excellent Double Helix Club for school science students run by the CSIRO, and by the outstanding productions of school materials by the Australian Academy of Science.

There is a need both for a general scientific and technological literacy, as well as a need to bring out the best in those students with a real potential for excellence in science. Neither of these objectives is being achieved at present. Let me cite a couple of pieces of evidence. A bipartisan standing committee of the House of Representatives last year concluded that a quarter or more of students leaving primary school lack adequate literacy and numeracy skills. These are precisely the students most at risk of finding that the jobs once available for those with lesser skills in these areas have now gone offshore to lower wage countries

to our North. In an Australia which aspires to be a dynamic technologically advanced and full employment society, this is totally unacceptable. At the other end of schooling, the evidence is that the scientific literacy of Australian students is declining, not relative to past measures of achievement, but relative to other countries. Many students are taught mathematics and science subjects by teachers who have not studied these fields at university. Ninety percent of science teachers in primary schools have no post-secondary science background. It is certainly no criticism of the teachers who find themselves in this situation to say that it is hardly surprising that many students do not carry with them a real understanding of the excitement and interest of these vital technologies, and are not enthused to pursue them at higher levels of study.

There has also been some pressure to water down, rather than strengthen the curriculum. The Academy of Science expressed its concern that the draft Science Profile being proposed seemed to be driven more by social and political agendas than by a concern to teach basic disciplinary skills. Young Australians will also form their sense of the status of science and engineering and the value placed on it by observing the priority governments give to it in their funding of education and research. Those who have made the transition to tertiary study cannot help but be aware that in the changes to the funding of universities in recent years the opportunities for graduates to gain research experience have been reduced. The *clawback* of funds from the operating grants of universities has significantly reduced the opportunities for younger researchers.

Competitively allocated research grants through the ARC and NH&MRC have not generally carried infrastructure funding. In the competitive research grants process through the ARC which has assumed much greater importance, younger researchers cannot but be aware that they and their colleagues are increasingly likely to swell the ranks of the 75-80 per cent of unfunded applications. In their own institutions they see the declining research infrastructure and must be aware that the government has rejected the expert recommendations of the Boston Research Group and the government's own National Board of Employment Education and Training for the funds necessary to restore this infrastructure up to a satisfactory level.

Governments must face up to the need for increased funding in science and the need to provide proper infrastructure and administrative support for research projects. The failure to address this matter puts at risk the training of the next generation of researchers. As the Government's former chief Science adviser, Professor Ralph Slatyer, has pointed out, if the Minister found the scientists he met were increasingly middle aged, he should also have recognised that such a trend is a direct result of policies which discriminate against the coming generation of scientists, and which are pushing many of the best and brightest of that generation out of Australia.

Moreover, what has happened in the last year in relation to the nation's premier industrial research organisation, the CSIRO, could only confirm in the minds of young Australians looking for a career in science that at present there is little understanding of the nature of scientific research on the part of those who control policy and that the views of scientists count for little in that policy-making. Without any consultation, and without any announced national policy framework or strategy, there sprang half formed from the former Minister's mind a scheme to reorganise the major scientific agencies in nuclear and marine science.

The motivation, as far as one could judge it, seemed to be entirely political. Doubtless schooled by John Dawkins, the Minister seemed to take the view that to act was everything, and hang the consequences. That is how names are made in this government. As it was, only in the face of the outrage of scientists from across the country, with the Presidents of the Academies of Science and Technological Sciences and Engineering describing them as *against the national interest* and *most ill-advised*, and with the Coalition making clear that we would oppose these changes in the Senate, did the government cut the Minister loose.

This was not however the end of the matter. This week, up to 600 scientists at the CSIRO

face the sack because the triennial funding arrangement for the CSIRO has effectively collapsed. Funding decisions which should have been made eighteen months ago are still unresolved despite the fact that the financial year to which they relate is almost here. The current high uncertainty which the CSIRO faces, however, can only spring from a government which fails to recognise that scientific programs are not planned days, weeks or even months ahead, but can only be planned on a long term basis. This was presumably the basis for the original decision to provide the CSIRO with triennial funding, yet the present situation is a direct denial of that understanding. And this is the government that during the 1993 Federal election campaign promised the CSIRO certainty and security of funding - another broken promise and one very damaging to the nation's scientific effort. Australian science will not survive at world class quality unless the funding mechanisms acknowledge the long lead times in planning scientific research.

The primary function of a body such as the CSIRO is strategic research. The proper planning and execution of this research requires stability of policy and certainty of funding. That is currently being denied and, as a consequence, that whole enterprise risks severe damage. Equally, it is crucial that there be a framework of public policy which encourages companies to want to invest in research and development. It has often, and correctly, been said that one of the continuing problems in the financing of scientific and technological innovation in Australia has been the lack of a medium and longer term perspective on research and development. Venture capital has been hard to come by because investors are unwilling to wait for a return. In Japan, the United States and Europe it is recognised that the pay-off from research may take many years and careful planning.

Science in Australia today needs the certainty and security that comes from certainty of funding. Even more, it will come from knowing that its place in Australia's future is both understood and appreciated. In the end we need to recognise as a nation that a strong science and engineering base is not an option - it is a fundamental necessity. It is a necessity if we are successfully to grapple with the whole range of challenges we face - from the greenhouse effect, soil degradation and feral animals to working effectively with the countries in our region of the world as they attempt to build the roads, ports, transport, telecommunications and other infrastructure which are essential to support their continued economic progress.

Nor are science and technology in separate and distinct boxes from the humanities and the arts. On the contrary, increasingly, the opportunities arise from bringing these cultures together in a partnership which will support world class design and development in architecture, fashion, telecommunications, transport, urban and environmental planning and so forth. If we are to gain the capacity to develop more Australian technology in Australia and to slow the brain drain of our best and brightest to other countries, changes to the national approach to science policy and to policy for science are essential. It is to these changes that I want to turn in closing my remarks.

A government has not done its job when it has, until very recently, sloughed off science to a junior Minister. Senior Ministers have to be prepared to concern themselves with policy and strategy in this area. In the Coalition's view, science and technology and their relation to industry policy and export development merit a Cabinet level appointment. The Government was very slow to recognise this fact. Just as important, however, is a policy culture in which the relevance of science and technology to all the activities of government is well understood.

The Prime Minister's Science and Engineering Council should express this viewpoint, but it is quite unsatisfactory if, as happened I understand at the last meeting, a number of the senior Ministers involved do not feel it worthwhile to attend. It is vital that there is a capacity at the centre to think and plan strategically, and I certainly do not see this adequately expressed in current arrangements.

What is needed above all is national leadership. Leadership which can express a vision and a strategy for the development of Australia as a scientifically and technologically advanced society in terms which have meaning in the very different world environment in which we find ourselves today. This in turn means a government which has a genuine interest in establishing processes which can involve the science and engineering worlds in the development of that strategy. This strategy must extend all the way from primary school to the export market. It must face up to the issue of priorities and to the need to put resources behind these priorities. Not only must we face up to the need for quality and standards in schooling and the need for a flexible vocational and training system, but it is essential that we acknowledge that the primary roles of universities in this regard are to undertake fundamental and basic research and to take the next generation of scientists and engineers. However much the importance of the commercialisation of research is emphasised, is current rhetoric. It is vital for the future of Australia as a scientifically and technologically advanced society that the fundamental and independent role of the universities is not compromised and that the resources of the structures are in place to ensure that these roles can continue to be performed at the highest levels.

Again, the uncompetitive business taxation system which is currently holding back innovation and investment in this country is in need of significant reform. The taxation framework must recognise the need to encourage investment in long-term infrastructure and in technology developments with long time-frames. It must face up to the need for small and medium-sized enterprises to acquire and build up their capital, and to have the cash flow to finance expansion. The rigidities in the workplace which have recently been reinforced by the Brereton legislation, and which the Carnegie Commission identified as possibly the greatest obstacles to innovation in Australian business must be removed. A new emphasis must be placed on co-operation, flexibility and productivity. We are looking at some exciting and imaginative approaches in this regard. For example, the Coalition is doing a lot of work on an appropriate employee share ownership scheme which would help dramatically change work place attitudes and flexibility.

There is plainly also a need for much more effective mechanisms to link the smaller and medium sized enterprises to the export markets. The Liberal and National Parties have long promoted the importance of science and technology for Australia's future. The development and expansion of access to education has been a central part of the liberal tradition in this country for over a century.

It was a Coalition government which established the CSIRO in 1927. Over fifty years ago Robert Menzies said that a world in which film stars were paid fabulous sums while scientists suffered neglect was a world which needed its sense of values set right. It was the Menzies government which undertook the massive expansion of the universities as teaching and research institutions. The first press release of the Fraser Government in 1975 announced the direct responsibility of the Prime Minister for the newly established Science and Technology Council and right through that period ASTEC was a valued and key advisory body.

Over the last decade there has been no effort to develop a national strategy which gives science and technology its proper place in Australia's future. The only things that stand in the way of the development of that strategy area lack of genuine vision and the constant distraction of irrelevant political agendas.

Australia cannot afford to wait much longer if we are to avoid being relegated to an increasingly minor place, even in our own region of the world. There is a magnificent and exciting future ahead of us. There is the prospect of once more returning to a world in which all young Australians can look forward to the opportunity for satisfying and fulfilling careers. But this will only happen if we capture a vision of the future as we want it to be, and that is a future in which our ability to make the best of our scientific and technological skills is central to what we set out to do.

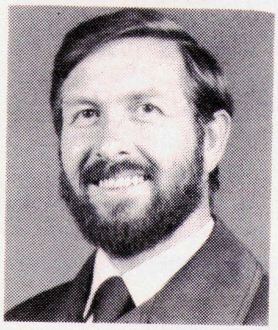
It is an exciting future for science and technology - I hope we can all share in that excitement.

I am very appreciative of the opportunity you have given me today to address some of the fundamental concerns which we in the Coalition Parties have in relation to the current direction of science policy. Over the coming months, we will be reviewing and developing our policy response to these issues. In that process, David Kemp and I look forward to an ongoing dialogue with you. Our aim, as always, is to implement a national policy that does justice to the talents and skills of our scientific community - and to do so in a way that benefits all Australians.

In meeting that challenge, I look forward to many other occasions such as today's.

Dr John Hewson MP
Leader of the Opposition
Monash University, 27 April 1994

POSSIBLE COLLABORATION IN ENGINEERING EDUCATION WITH WESSEX INSTITUTE OF TECHNOLOGY IN THE UNITED KINGDOM



Prof. T.V. Duggan

During his visit to Europe in February, 1994, Associate Professor Zenon J. Pudlowski, Director of the UNESCO Supported International Centre for Engineering Education, based at Monash University in Melbourne and the Executive Director of the AAEE made a visit to the prestigious Wessex Institute of Technology (WIT) in the UK, to discuss possible links between WIT and the International Centre, with WIT's Principal and Founder, Professor Carlos Brebbia.

The Wessex Institute of Technology is a research centre with an international reputation for engineering excellence. This is based on solid and outstanding achievements and a commitment to research of the highest quality. The Institute's record of consistent high achievement in working on projects which are highly valued by industry and business in general has resulted in a series of successful initiatives now being widely used by industry. This is testimony to the quality of work carried out, and enables WIT to provide a realistic environment for research and a unique opportunity for postgraduate studies.

WIT is fully committed to research and postgraduate training, and research students and visitors work in an atmosphere where teamwork is a high priority. Research and supervision are essential functions of the academic staff, and researchers have the opportunity to discuss their projects with advisors practically on a daily basis, in contrast to the experience in most conventional universities. Courses and seminars, tailored to meet the specific needs of the researchers, are held at frequent intervals. The facilities available for research include the latest workstations, access to large main frame computers off campus, and a well equipped specialised library containing books and journals dealing with numerical and computational methods in engineering.

Industry and government organisations have recognised the achievements of WIT, and the Institute is well supported by research funds. One of its most outstanding features, is the close collaboration which WIT has established with other academic, research institutes and industries across the world. This distinguishes it from other universities, providing an effective international link between academia and industry. A comprehensive range of research programmes is provided, and there is no doubt that WIT is amongst the best engineering Institutes in the world for graduate studies.

The core strength of the Wessex Institute of Technology is based on the application of numerical engineering and computational methods to the solution to a wide range of engineering problems. An internationally recognised research team has been established, consisting of eminent researchers investigating computational techniques for solving advanced engineering problems. The Institute has pioneered the developments of advanced techniques for engineering design and analysis, including the boundary element method, dynamics of structures, stress analysis, heat transfer, electrical conduction, fluid mechanics, hydraulics, environmental engineering, materials engineering and advanced computing.

The Institute has three major Research Divisions, each engaged in a specific but broad-based area of engineering; these three Divisions are designated as Computational Mechanics, Damage Tolerance and Advanced Computing. The Computational Mechanics Division is primarily dedicated to novel formulations and applications of computational methods to a very wide range of engineering problems, and has pioneered the development of Boundary Element Methods and their application. The Damage Tolerance Division carries out research on computational methods in the field of solid mechanics and materials engineering, with particular emphasis on fracture mechanics and its application in damage tolerance design. The Advanced Computing Division is involved in the application of high performance computing for the solution of numerically intensive engineering problems, with particular emphasis on the implementation of vector and parallel algorithms.

In addition to its impressive high quality research and graduate study programme, the Institute provides a programme of training and short courses, and invited lecturers include the leading experts in the field. These courses, conducted at the Institute, are designed to increase the awareness of researchers of the best work in their particular area, and provide motivation and incentive for the exchange of new ideas with other international research groups. The Institute has also acquired an international reputation for its conference programme which comprises approximately 20 conferences per year, held in different locations throughout the world. The range of subjects covered is very impressive indeed, and some of the areas in which training and recent international conferences have been organised include the following:

* Acoustics
* Artificial Intelligence
* Boundary Elements
* Composite Materials
* Contact Mechanics
* Electrical Engineering
* Fluid Flow
* Hydraulic Engineering
* Localised Damage
* Marine and Offshore Structures
* Moving Boundaries
* Optimisation
* Railways
* Soil Dynamics
* Supercomputing
* Urban Transport
* Air Pollution
* Biomedicine
* Coastal Engineering
* Computer Visualisation
* Damage Tolerance
* Environmental Engineering
* Heat Transfer
* Ice Technology
* Marinas
* Materials
* Numerical Methods
* Performance Computing
* Software Quality
* Structures
* Surface Treatment
* Water Pollution

The Wessex Institute of Technology was founded by its Principal, Professor Carlos Brebbia, in the mid eighties, and under his direction and leadership the Institute has continued to expand and prosper. It is an entirely independent academic institution, and the only one of its kind in the United Kingdom. Located at Ashurst Lodge in the heart of the New Forest, close to the Solent Area in the South of England, the Institute offers a tranquil environment in which to carry out research and training activities. Within its grounds of 14 acres, the Institute has cottages on campus and individual bedrooms for student accommodation. The

Solent area is rapidly expanding and has two major cities, Southampton in the West and Portsmouth in the East. Portsmouth, which was the venue for the 1992 World Conference on Engineering Education, has a rich history as the major Naval Port of England. The Royal Dockyard is the traditional home of the Royal Navy and is now a world famous centre of maritime heritage. Portsmouth is also the birthplace of Charles Dickens. Southampton, a growing modern city is renowned as a major European port, a city of great historical interest, with many well preserved relics of its medieval past. Both Portsmouth and Southampton are lively cities and within easy reach of many areas of natural beauty. To the west of Southampton lies the New Forest, first designated as a royal hunting reserve in the Eleventh Century, and now a National Park.

The meeting between Professor Zenon Pudlowski, Professor Carlos Brebbia and Professor Terry Duggan, together with discussions with other leading staff at WIT, was extremely interesting. A number of potential areas were identified for possible future collaboration between the Wessex Institute of Technology and the UNESCO International Centre for Engineering Education. In particular, the expertise of WIT could be of considerable value in providing training and conferences in the area of computational methods for academic staff. Furthermore, the synergy resulting from collaboration between WIT, with its excellent international profile under the dynamic leadership of Carlos Brebbia, and the newly established UNESCO International Centre for Engineering Education, under the direction of Zenon Pudlowski, one of Australia's key engineering education proponents, has considerable potential for establishing and coordinating an international network in appropriate areas, such as environmental engineering.

Prof. Terry V. Duggan
Pro-Principal
Wessex Institute of Technology
United Kingdom

INNOVATIVE TEACHING IN ENGINEERING DESIGN

Dr B.W. Field

Introduction

In the second half of 1993, I attended two European conferences, about one month apart. Rather than return to Australia between the conferences, I chose to remain in Britain and study some of the teaching programmes in engineering design.

Up until only about ten years ago specialist Australian engineering design teachers could not learn very much in their discipline from British Universities - the majority of British courses were BSc degrees, with emphases on the engineering sciences, and minimal effort spent on design studies or organised design projects. Then there were two important changes. The first was the realisation in British industry that Design was a major weakness in engineering graduates, and the second was the changing status of Polytechnics into Universities, following a similar rationalisation in higher education to that experienced in Australia.

A series of British Government-sponsored reports, such as the Finiston Report in 1980, *Engineering our future* and a second in 1991 headed by Prof. Gordon Wray (who visited Australia and presented seminars in 1992), entitled *Attaining competence in engineering design* prompted a changing focus on the study of engineering design, and the major universities began to improve their programmes (especially Cambridge), while the *new* universities such as at Bath, Portsmouth, Coventry and Loughborough with established engineering design courses from their previous polytechnic status (and a corresponding lack of research work in their undergraduate programmes) rose to new prominence.

I took the opportunity to visit three of the ex-polytechnics with reputations in mechanical engineering design, and to participate in the undergraduate programme at one of them.

University of Bath

There were three especially interesting features of the undergraduate teaching programme in mechanical design at Bath.

The first was the focus on a major design project in their final year (not unlike most mechanical engineering courses in Australia). Students undertaking the course had a choice between a major design (and build) project in pairs, always sponsored from local industry, or a smaller design (and mock-up) in larger teams of about seven students. These latter students also undertook a larger project in a non-design area, so the workloads of the two groups of students were matched. In both cases, however, the presentation of their work included three activities: a design report in much the same form as we use in conventional design teaching; a poster; and a formal presentation of their design at a seminar day including all of the industry sponsors, a guest speaker from industry, and an *exhibition hall* of the posters with the designers.

The posters had a useful long-term effect, as they were retained by the department and displayed in the corridors for one or more years. A visitor entering the department was immediately impressed by the apparent amount of work being done, and the recency of that work. This is in contrast to many of the *permanent* displays in some of our engineering schools which have been unchanged for many years.

It struck me that this style of design presentation, which became a major event in the academic year, attended by the vice chancellor, and given publicity in the local media, would be fairly easy to adopt for our final year project work - be it research project or design project. At present, details of most of our students' work remains fairly restricted, perhaps being aired at seminars presented by students themselves as a part of the assessment of communications skill. The public nature of an open *poster day* with industry representatives, most of the academics in the department, and several from outside the department, plus undergraduate students from earlier years brought out the professionalism in the students and gave them a sense of pride in *completing* their undergraduate studies.

Two bonuses to this technique become apparent.

The first is an opportunity for the academics to quickly sum up the quality of the work done by other students (besides their own project students) prior to assessing their own project students. This should reduce the anomalies in final year project marking which creep in when there are perhaps one hundred different projects, assessed by some twenty different academics (such as in the Mechanical Engineering department at Monash University) and the project work counts for so much of the final honours grade (25% of final year at Monash). It is otherwise very difficult to ensure that grades are fairly distributed across the class.

The second bonus is in the decoration for the otherwise drab halls of the department. As noted earlier, the recency of the posters gave a liveliness to the department, provoked discussion in the corridors, and no doubt eased the workload when University open days came around each year.

The second feature of the design work at Bath was the development and use of *selectors* of materials and machine elements in a PC-based CAD facility. Besides the well-established Cambridge Materials Selector, students had access to other commercial selectors in materials, bearings, Fenner belts, gears and springs as well as internally developed selectors in seals, bearings, electric motors and toothed belts. Bath had an on-going programme to develop selectors for both educational use and commercially.

The third feature of the engineering courses at Bath was the existence of streams in Engineering with a European Language. These were not simply a form of a BE/BA with separate language studies, but were courses in which some of the engineering subjects were presented entirely in French or German (as well as a stream in English for students who were not enrolled in the engineering-with-language option). This was aimed at developing competence in technical communication in the other language, which would not have otherwise been possible from the language school at Bath.

University of Coventry

I spent two weeks at Coventry during the start of their new term. The School of Engineering is headed by Prof. Derek Sheldon, who is also the chief editor of the Journal of Engineering Design, but I spent most of my time with Mr Michael Blamey who led the course in design management. The School (reputed to be the largest engineering school in Britain) included closely knit departments of mechanical/manufacturing, and automotive engineering (being surrounded by British automotive manufacturers). Again, being a former polytechnic, the major focus during the final year was on design, rather than research, and the approach to the major final year design management project was both innovative and effective.

The department obtained about eight substantial manufactured products (for example an airline seat, a VCR etc) and left them permanently in a *design office*. Teams of five students worked on each of the items for half a day per week. Other teams worked on the same items on other days: in fact there was only one half day per week that the office was not allocated to this project work (there were more than 200 final year students enrolled in the subject) and this explains why the pieces could be left in the office permanently. The students were to report on all aspects of the design and manufacture of their allocated equipment, principally drawing on their prior learning: there were no formal lectures in this subject.

Several courses in Australia use this type of approach, which is a form of Problem Based Learning (PBL). I use it extensively at Monash University when teaching manufacturing methods at both introductory levels (using artifacts made by basic forming and machining processes) and advanced levels (using items made with non-traditional processes, and seeking understanding of jigs and fixtures, or automated assembly), and Mary Gani of Materials Engineering at Monash has used the technique with her students, seeking mainly the identification of materials used in the artifacts.

Since many of the students in Coventry had previously gained relevant work experience (there was an approximately equal mix of local students and students from the Continent, undertaking their final year in an extensive exchange programme), there was a formal method of trading information between different groups. One group would *advertise* for expertise in a required area (for example the construction of electrical wiring harnesses) and offer to swap their expertise in other areas. There were *penalties* associated with contacting industry, so groups working on the same piece of equipment collaborated in approaching industry, and thereby maintained good relations, in spite of the numbers of students involved. The classes ran in unstructured ways, with coffee facilities at one end of the office, and bulletin boards for passing and sharing information. A general notice board was used for the advertising of the group's skills, and in requesting specialist skill. Individual notice boards were used for passing information between the groups working on particular items, as there was apparently little personal contact made between the separate groups working on the same item because of the very large numbers of students in the course, multiple streaming and heavy contact loads.

While the formal educational aims of the subject were for students to learn about manufacturing systems, there were clear spin-offs from the technique used by Michael Blamey. The groups were large enough, and the projects extensive enough (the one project

occupied the whole of the subject) that personnel management, time management, negotiation skills, information gathering skills and presentation skills were all developed and exercised.

This course was the largest example of the effective use of PBL that I have observed.

Loughborough University

Loughborough had two special attractions: it was the base from which Prof Wray promoted design as a university discipline of equal status to the engineering sciences, and they operated a master's course in design by one-week intensive modules, with assessment after six or more modules, which enabled them to offer the modules as short courses. I was interested in exploring how the separation of presentation and assessment affected student learning as it seemed to be an attractive concept to use at Monash University. The undergraduate programme in design followed a fairly conventional (by our standards) path terminating in a major final year design project of a design-and-build type. The staff were of the opinion that the post graduate structure worked well with some of the assessment for early modules conducted during the week of the module, and with successive modules drawing to some extent on the earlier ones, thus adding reinforcement, and they were satisfied that the educational outcomes were unaffected by the structure. Post graduate courses from other departments were in fact beginning to adopt the same approach. Paradoxically, the design master's structure was about to revert to a more conventional style because the economic downturn had reduced enrolments, and the University had independently forced a change to the module size in master's courses which meant that subject amalgamations were required within the design master's programme.

Conclusions

While it is true that in general, Australian courses in engineering design (at least in mechanical engineering) are well presented and focused, there is still plenty of opportunity for us to explore alternatives developed by our counterparts on the other side of the world. I am more concerned that the richness and variety of learning which occurs in design subjects, especially those which make extensive use of PBL, is being denied to many engineering undergraduates in courses with minimal design work, or design work restricted to the systematic application of Design Codes. I commend the use of PBL in the teaching of all branches of engineering, and not just in design work.

The broadening of engineering education in Britain was interesting. While the major suppliers of engineering graduates on the Continent traditionally included English language in the secondary, and often tertiary programmes, Britain is now realising that to give their engineering graduates the best opportunities to practise in Europe, or indeed elsewhere, foreign language and culture studies are required. With specific language programmes at Bath (which is not unique) and extensive exchange programmes at Coventry, students are being prepared for the global engineering market. How long will it be before we in Australasia find it necessary to adopt a similar broadening in order to focus on the Asia-Pacific engineering community?

Dr Bruce W. Field
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CURRENT ISSUES IN ENGINEERING EDUCATION IN AUSTRALIA

As Foundation Director of the UNESCO Supported International Centre for Engineering Education (USICEE), I am pleased to report to our readers that the USICEE commenced its operation on 1 January 1994. The Centre is privileged to host the headquarters of the

Australasian Association for Engineering Education and its scientific journal (AJEE). The Secretariat of the International Liaison Group on Engineering Education (ILG-EE) has also been moved to the USICEE.

After only four months of operation, the Centre employs a part-time administrative officer and a full-time project officer. Such a dynamic growth of the Centre, in a short time, was possible because the management of Monash University has seen the Centre as extremely relevant to the entire process of internationalisation of education at Monash University.

We are delighted to acknowledge the financial and moral support of Monash University, and in particular that of Professor Peter LePoer Darvall, now the full-time Deputy Vice-Chancellor (Research and Development), without which this Centre would not exist. The 1994 commitment from Monash totals close to $250,000, including a recent grant of $50,000 received from the Monash Development Fund.

Special gratitude is expressed to the Vice-Chancellor of Monash University, Professor Malcolm I. Logan and the Deputy Vice-Chancellor, Professor Ian W. Chubb for their personal interest in the Centre, as well as their strong support for its operation. With this sort of patronage the Centre's future looks particularly bright.

We are pleased to note that the Australian Ambassador to Poland, the Czech Republic and Slovakia, His Excellency Anthony C. Kevin, has been the first to respond to USICEE's call for support and was instrumental in awarding the Centre an AIDAB grant to finance a project on engineering education for those three countries.

Our relationship with UNESCO strengthens almost every day. The Centre has recently established its links with the UNESCO Regional Office in Jakarta and with the Australian National Commission for UNESCO. It is particularly encouraging to learn that the Australian National Commission for UNESCO believes that engineering education is a priority field and has expressed its support for the USICEE. This places the Centre in a much stronger position in the Australian scene.

With this fact in mind, the Centre now endeavours to expand its base by establishing a network of academic and industrial partners with whom to collaborate on projects in engineering education and industrial training. It aims to become a research arm of a number of key players concerned about engineering education such as UNESCO, The Institution of Engineers, Australia, the International Liaison Group on Engineering Education, the Australasian Association for Engineering Education, and others.

In recognition of the high standard of Australian engineering education, the Centre has been chosen by the UNESCO Steering Committee on Human Resources Development for Technical Industry Stimulation to host and organise, on behalf of UNESCO, the *1995 International Congress of Engineering Deans and Industry Leaders*. This is the first time that this important UNESCO Congress will be held away from UNESCO headquarters in Paris. A preliminary call for papers and an invitation to attend the Congress is now being circulated throughout the world, and readers will find a copy included with this Newsletter. We would, indeed, encourage our readers to submit a paper proposal and attend the Congress.

Engineering and technology education has become a hot issue. The debate on the quality of engineering education has extended from academia to industry, professional organisations and even to politicians. On Wednesday, 27 April 1994, Monash University hosted Leader of the Opposition and Shadow Prime Minister, Hon. Dr John Hewson, accompanied by his collegue, the Shadow Minister for Science, Technology and Export Development, Dr David Kemp, himself a former Monash professor. Dr Hewson presented an excellent address on the importance of science, technology and engineering for the development of Australia (included in this issue). The address generated interesting discussion with several question from the floor, skilfully answered by both leaders. There was general consensus amongst academics

that Dr Hewson has initiated a debate which may dramatically change the way in which this country has recently abandoned the interest in, and support for, science, technology and engineering. Engineering educators were particularly pleased to hear the word *engineering* being used by Dr Hewson on a number of occasions.

Engineering education in Australia is shaping up extremely well with many interesting activities to emerge in the local and international arena. In November 1994 Dr Adnan Badran, the Deputy Director-General of UNESCO and our strong supporter, will be in Australia. Dr Badran has accepted an invitation to address the Opening Ceremony of the *Electrical Engineering Congress (EEC'94)*, to be held between 24 and 30 November 1994 in Sydney. The Congress is sponsored by The Institution of Engineers, Australia, and organised by a team of professionals mostly based at the CSIRO. The Congress streams include a wide range of topics and issues in electrical, electronic and communication engineering, including electrical engineering education. A call for papers was distributed together with the AAEE *Newsletter*, Vol.6, No.1. We would urge electrical engineers and electrical engineering educators to attend this important gathering.

We should mention with satisfaction that Dr Badran will visit the USICEE, and also will present an address to staff members of Monash University on the role of UNESCO in enhancing human resources for science, technology and engineering in developing countries. At USICEE, Dr Badran will be briefed on current issues of importance for engineering education and the achievements of the Centre. The preparation for the *1995 International Congress of Engineering Deans and Industry Leaders* will also be high on the agenda.

OUR PRESIDENT GAINS NEW TITLE!

Professor Peter LeP. Darvall

President of the Australasian Association for Engineering Education, Professor Peter LePoer Darvall, has many other titles already - Dean of the Faculty of Engineering at Monash University, Chairman of the UNESCO Supported International Centre for Engineering Education, Member of the International Liaison Group for Engineering Education, Fellow of the Institution of Engineers, Australia, and ... Poet - but now he has a new appointment as full-time Deputy Vice-Chancellor (Research & Development) at Monash University.

In his new role, Peter Darvall will report to the Vice-Chancellor and have overall responsibility for the development and implementation of research policies across the university. He is well-qualified for this work because of his extensive academic experience in Australia, the USA and Mexico and his many years work as Member of the Monash University Council, President of the Staff Association and President of the Federation of Australian University Staff Associations (FAUSA) where he helped develop national policy for the expansion of research funding and the improvement of conditions for university staff.

Professor Darvall's new position follows logically from his deep commitment to quality in tertiary education, particularly engineering education. He has been involved in many initiatives to improve academic teaching techniques and has made an active contribution to conferences and journals through his various roles in engineering and engineering education.

It is sad that Peter Darvall's drive and enthusiasm will be lost to the Faculty of Engineering

THE INTERNATIONAL LIAISON GROUP ON ENGINEERING EDUCATION (ILG-EE)

The International Liaison Group on Engineering Education (ILG-EE) is an independent Working Group, promoting international activities in the field of engineering education. It is sponsored by international and national organisations and supported by member countries with active programs in engineering education.

Objectives:–

- To promote the exchange of information and facilitate scientific co-operation among national programs of common interest.
- To propose and co-ordinate the organisation of meetings in the field, in particular international conferences.
- To identify problems of practical interest and stimulate co-ordination of research and developmental efforts.
- To assist members and sponsoring organisations in carrying out activities relevant to their programs.
- To serve as a means of disseminating information on progress to member countries and sponsoring organisations.

Membership

The ILG-EE includes one or two members and one or two alternate members nominated from member organisations and/or individuals who have an interest in engineering education. In nominating members of the ILG-EE and their alternates, organisations or individuals should be guided by the following:–

- Each member and his/her alternate will be a scientist or an engineer, having an active interest in engineering education or having broad responsibilities for programs in this field.
- Each member and his/her alternate may be nominated by an organisation or an individual known to the ILG-EE.
- Each member or his/her alternate may be accompanied by advisers or specialists to any meetings of the ILG-EE.

The ILG-EE may invite to its meetings observers and consultants on an ad-hoc or continuing basis. The nomination of members and alternates is confirmed by the ILG-EE.

Sponsorship:–

- National and international organisations are invited to become sponsors of the ILG-EE. International sponsoring organisations are recognised as international sponsors, national sponsoring organisations as sponsors. Sponsors may apply for membership for a specified term, as approved by the ILG-EE. After acceptance by the ILG-EE as members, they will have voting rights.
- Industrial organisations are invited to become sponsors of the ILG-EE for a specified term, on the basis of support rendered as approved by the ILG-EE. Industrial sponsoring organisations are recognised as industrial sponsors. They may participate in all ILG-EE activities and attend its meetings. They have no voting rights. They may invite observers to participate in activities and meetings of the ILG-EE.

Professor Terance V. Duggan
Chairman

Associate Professor Zenon J. Pudlowski
Secretary

For further details on membership and sponsorship please contact the AJEE Editor-in-Chief.

but his commitment to engineering education will remain through his various important roles, including the Presidency of the AAEE and his Chairmanship of the USICEE.

The editorial team wishes Professor Darvall every success in his future endeavours and convey congratulations and best wishes on behalf of all members of the AAEE.

The picture above shows Ashurst Lodge which is located in the New Forest, a beautiful area of southern England. This historic building houses the Wessex Institute of Technology (WIT), now an integral part of the University of Portsmouth. In September 1992 the University of Portsmouth hosted the 3rd World Conference on Engineering Education so successfully staged under the chairmanship of Professor Terry Duggan. Prof. Duggan's article about the WIT is included in this issue.

For details of the Association and membership applications write to the Editor:

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Association members and academic institutions are invited to contribute to the Newsletter on matters relating to membership and engineering education.

Send contributions to the Editor at the address above.