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The Journal of The Institution of Engineers, Australia

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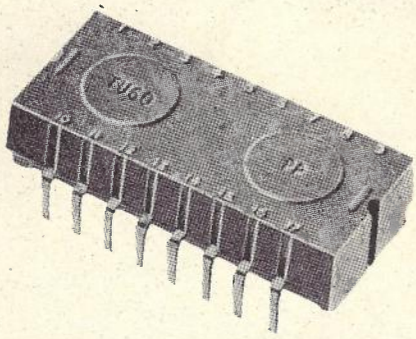

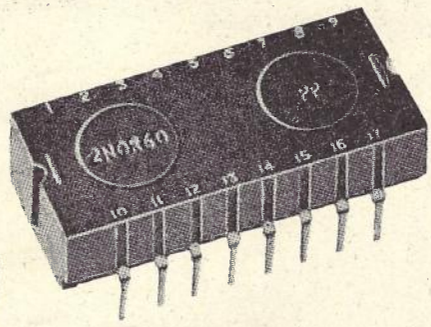

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CONTENTS

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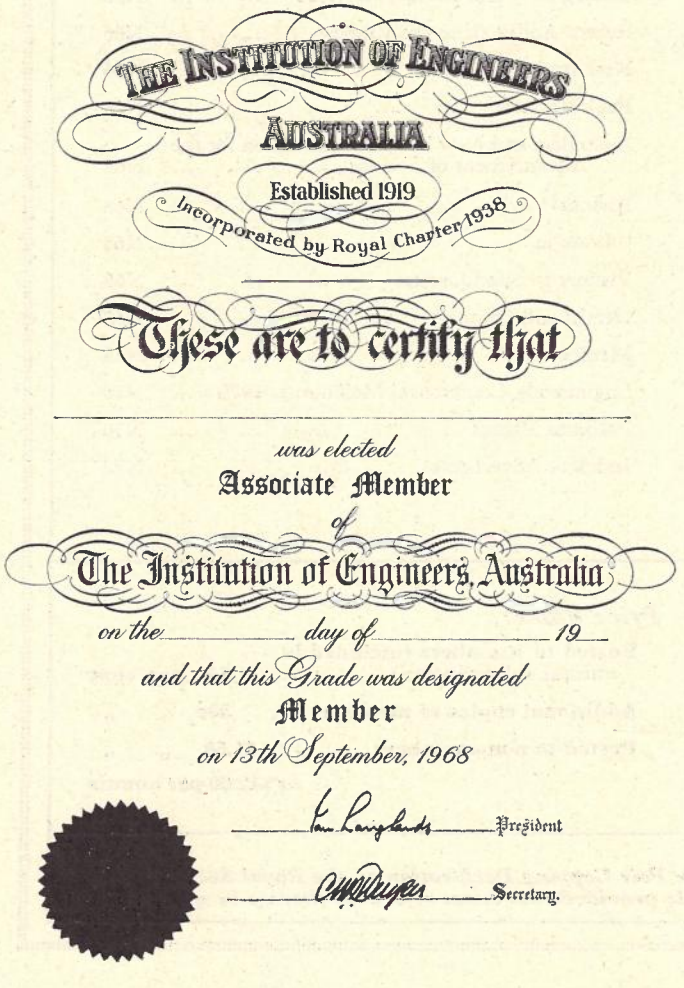


Forthcoming Conferences and Symposia

Sponsored by the Council of The Institution

Hydrology Symposium,
Hobart, 18th and 19th February, 1970

Engineering Conference, 1970
Melbourne, 16th to 20th March, 1970

Symposium on Soils and Earth Structures in Arid Climates,
Adelaide, May, 1970

Data Transmission Conference,
Brisbane, June, 1970

Thermodynamics Conference,
Adelaide, August, 1970

Engineering Conference, 1971
Adelaide, 21st to 27th March, 1971

Sixth A.-N.Z. Geomechanics Conference,
Melbourne, August, 1971

Sponsored by Divisions:

Symposium on Heat Exchange,
Brisbane, October, 1969
(Queensland Division)

Earthquake Engineering Symposium,
Melbourne, 16th to 18th October, 1969
(Victoria Division)

(The Symposium Bulletin was published as a Supplement to the July-August issue of THE JOURNAL.)

1919 1969

Jubilee

Presidential Address*

Fifty Years

BY IAN LANGLANDS, M.MECH.E., B.E.E., F.I.E.AUST.

OUR PARENT

Friday the second of January, 1818, may seem very remote from this week's Jubilee celebrations, but it is an important date to us here tonight as it was the day when the parent of The Institution of Engineers, Australia, and in fact the progenitor of all professional engineering societies as we know them today, was born. I refer to The Institution of Civil Engineers.

Exasperated and frustrated by the complete lack of facilities in England for obtaining organized training in civil (as distinct from military) engineering, eight young men, ranging in age from 19 to 32, met on that cold and foggy day in the Kendall Coffee House in Fleet Street to do something about it. Their leader was Henry Robinson Palmer (aged 23) who, in an outstanding address, defined the function of the engineer in words which are equally valid today—"An Engineer is a mediator between the Philosopher and the working Mechanic; and like an interpreter between two foreigners must understand the language of both. The Philosopher searches into Nature and discovers her laws, and promulgates the principles on which she acts. The Engineer receives these principles and adapts them to our circumstances. The working Mechanic, governed by the superintendence of the Engineer, brings his ideas into reality. Hence the absolute necessity of possessing both practical and theoretical knowledge".

It was decided "that a Society be formed consisting of persons studying the profession of a Civil Engineer" for the purpose of "facilitating the acquirement of knowledge necessary in the civil engineering profession and for promoting mechanical philosophy".

Thus, the founding of the great Institution of Civil Engineers was an early example of constructive student action. Not surprisingly, admission to the Institution was originally limited to men not less than 20 and not more than 35 years of age. But youth was better at originating than at implementing, and little progress was made until in 1820 the rule limiting the age of admission was rescinded and the great Thomas Telford, who was then 63 years of age and at the height of his fame, was persuaded to become the first President. Telford took his office seriously and because of his interest and efforts the young Institution grew in numbers and in stature, and in 1828 was granted a Royal Charter.

Under Telford's influence the Institution tended to concentrate its attention on roads and canals, and it was natural that the engineers in these fields did not take kindly to the advent of railways in 1825. A school of railway engineers arose which rightly considered that their interests were not being adequately covered, and in 1847 a meeting of railway engineers in Birmingham decided to form their own Institution of Mechanical Engineers with George Stephenson as President.

The creation of The Institution of Mechanical Engineers dealt a sad blow to the unity of the engineering profession and started the process of splintering that led in 1871 to the formation of The Institution of Telegraph Engineers (later to become The Institution of Electrical Engineers), and ultimately to 26 societies of engineers in the United Kingdom. As stated by Gerstl and Hutton† "this fragmentation of interests . . . constitutes one of the main reasons why the public image of engineering as a single profession is blurred and why its status is relatively low". Realization of this led, after prolonged negotiations, to the formation in 1965, by Royal Charter, of the Council of Engineering Institutions—a federation of the 14 more important specialist institutions in the United Kingdom. The Council has authority to speak and act on behalf of the profession as a whole, and considers that "this will do much to convey a more correct impression of engineering as an integrated profession". One of its early actions was to establish a common educational standard for admission to its constituent institutions at the level of a United Kingdom University degree in engineering.

I have traced briefly the story of what happened in Britain as I believe there are important lessons to us in the successes and, particularly, in the mistakes of our British colleagues.

OUR BIRTH AND GROWTH

The genesis of The Institution of Engineers, Australia, was entirely different from that of The Institution of Civil Engineers. It was an amalgamation in 1919 of twelve of the fifteen regional and specialist engineering societies that had been formed at various times since 1870, when the Engineering Association of New South Wales, a foundation society of The Institution, was established. Thus, in one sense we are approaching our centenary.

Two of the three societies that did not amalgamate in 1919 were subsequently absorbed into The Institution but the third, the Australasian Institute of Mining and Metallurgy, has maintained its identity and has grown into a powerful and influential organization of engineers and scientists engaged in the mining and mineral industries. Many engineers are members of both The Institution and the Institute.

Unlike The Institution of Civil Engineers which began with a mere eight members, the Australian Institution had a flying start with a foundation membership of 1,757 and is now the largest professional association in Australia with a membership of about 22,000. This increase over the 50 years corresponds to a doubling of the membership on the average every 13½ years. Growth was very fast during the first years but dropped

*To the Forty-ninth Annual General Meeting of The Institution of Engineers, Australia, on 17th April, 1969.

†Gerstl, J. E. and Hutton, S. P. "Engineers: The Anatomy of a Profession" Tavistock Publications, London, 1966.

drastically during the depression of the late 1920's and the early thirties. There was a rapid increase after the war but over the past 15 years the rate of expansion, with some fluctuations, has steadied at the 50-year average. If this is maintained the membership in the year 2000 will be about 110,000, rising to 300,000 when we reach our centenary in 2019. Extrapolation is always risky, but even a conservative estimate, based on the long-term experience of similar overseas associations, gives 90,000 in the year 2000 and 200,000 in 2019.

Of course, the importance of numbers must not be exaggerated but they do indicate the degree to which The Institution can justly claim to be representative of the profession. (Actually, about 70 per cent of the total number of professional engineers in Australia are members.) It is also undoubtedly true that, other things being equal, a large organization has greater influence and status than does a small one.

OUR FUNCTIONS

As stated in the Royal Charter, granted in 1938, the objects of The Institution are " To promote and advance the science and practice of engineering in all its branches and to facilitate the exchange of information and ideas in relation thereto and for that purpose . . . " ; then follow twelve sections the first of which reads " To raise the character and status and advance the interests of the profession of engineering and those engaged therein ". Subsequent sections give The Institution power to admit only persons adequately qualified in both the theory and practice of engineering ; to promote honourable practice ; to advance the education of engineers by any appropriate means and to hold examinations ; to establish libraries, museums and laboratories ; to encourage research and development ; to originate, promote, support or approve changes in the law ; and to promote and safeguard the interests of the profession generally.

The functions of The Institution can thus be summarized as :

To act as a learned society
To act as a qualifying body
To maintain high standards of professional conduct
To raise the status of the profession
To speak and act on behalf of the profession.

Let us look at what has been accomplished over our first half century in discharging these functions.

A LEARNED SOCIETY

From the beginning, the learned society function has been given prominence. During 1920, the first full year of existence, 51 papers were read and it was recorded in the first Annual Report that " The Council has noted with satisfaction the large number and high standard of the papers presented before the various Divisions ". The first *Transactions*, published in 1921, contained 16 papers.

Provision was made in the original Constitution for members engaged in the same sections of engineering to form Branches within Divisions for the purpose of closer co-operation in their own specialities. In the larger Divisions particularly, Branches have become increasingly important. In Victoria and Sydney Divisions, with nine and five Branches respectively, practically all learned society functions are handled by them, general meetings of the Divisions being confined either to joint meetings with Branches, or to Annual General Meetings and special functions such as commemorative orations.

After the Second World War, it became apparent that certain more highly specialized fields could be effectively studied only at the national level, and in 1947 Council broke new ground by introducing national Technical Committees, which include non-members as well as members. As a result of their efforts in organizing conferences, symposia and the like (of which four or five are held each year), coupled with the activities of the Branches, there has been in the past ten years particularly an upsurge in learned society activity as indicated by the number of papers submitted for publication, which rose from 48 in 1958 to 290 in 1968. (Of these about two-thirds are published.) Until 1958, THE JOURNAL was the only mode of publication of papers, but in that year, to give better service to the sections of the profession, specialized *Transactions* were introduced.

The marked increase in learned society activity is most gratifying but the consequent rise in the cost of publications, from 36 cents per annum per member in 1958 to $4.65 in 1968, is alarming, and some way of keeping costs to manageable proportions without reducing service to members will have to be found.

Two developments of potentially great significance to the future of The Institution have occurred in recent years.

During 1963, it became apparent that a body of feeling had developed among electrical and electronic engineers that The Institution was not meeting their special needs, and Professor R. E. Vowels suggested* that the learned society function could best be catered for by the establishment of " Boards " in the main fields of engineering, autonomous to the extent that they would be elected by the Corporate Members of The Institution in those fields ; that they would control their own publications and professional activities ; and that they would have direct representation on Council.

To study this proposal Council appointed a special Committee which, after obtaining the opinions of Divisions and Branches, reported that there did not seem to be a similar demand from members in other fields of engineering, who apparently were satisfied with the existing system of national Technical Committees and Divisional Branches, but that immediate action should be taken to develop at the national level the learned society functions of The Institution in the electrical and electronics field. On the recommendation of the Committee, Council appointed the Electrical & Electronics Board to arrange conferences etc. on a national basis and to advise on how the learned society activities in its field should be encouraged.

Although broader than science, engineering is science-based and the recognition of this was the motive for the formation of The Institution of Civil Engineers, as indicated by Palmer's description of the engineer as the " mediator between the Philosopher and the working Mechanic . . . ". Note, however, that he used the word " Philosopher ". Although many of my colleagues in the C.S.I.R.O. may not agree, there is a great difference between the philosopher, as understood by Palmer, and most scientists of today, and failure to recognize this leads to misunderstanding and to such statements as " Scientists and engineers have different motives. Scientists are interested in discovering the secrets of nature, and engineers in applying them to man's use and benefit ". If the word " Philosophers " is substituted for " Scientists " in this I would agree. But the fact remains that the great majority—at least 80 per cent—of people with academic qualifications in science (whom we call " scientists ") are more concerned with applying the secrets of nature than in discovering them and thus they have the same basic motives as engineers even though their training is different.

In many fields, this type of scientist (whom I will call an " applied scientist " even if his academic training was in what is usually called " pure " science) and the engineer work as a team. This gave rise to a need for a means whereby they can conveniently and regularly meet on an equal footing to discuss matters of common interest. But for reasons arising from its qualifying function it is difficult for a person with qualifications in science only to become a member of The Institution and relatively few have done so. To meet this problem the non-corporate classification of " Affiliate " was created last year to enable applied scientists to take a full and equal part in the learned society functions of The Institution. It is too early yet to say how successful this innovation will be, but I am hopeful that it will lead to closer co-operation within The Institution of engineers and applied scientists and so counter a major argument for splinter groups.

A QUALIFYING BODY

The second function of a true professional society (as distinct from a study group) is to ensure that its members possess high standards of competency. Again this responsibility was accepted by The Institution from the start, the first Constitution demanding that every candidate be required to pass, or be exempt from, an examination prescribed by the Council and that, in addition, Corporate Members should have a minimum of three years of satisfactory experience.

Over the years, The Institution has greatly raised the standard of its examination requirements, and thus the quality of engineering education throughout Australia. The most recent change is the requirement that after June, 1980, The Institution will accept only qualifications obtained after a four-year post-matriculation full-time course or its part-time equivalent, so extending the present minimum requirement by one year. This increase in academic standards is considered necessary because of the great advances that are taking place in science and technology, and is in line with recent developments in the United Kingdom and elsewhere.

The Institution does not believe that professional societies should draw up syllabuses either to be adopted by, or for the guidance of, educational authorities as it considers that they should be free to arrange their own courses and to amend them from time to time in the light of scientific and technological advances. However, courses submitted for recognition must satisfy specified requirements as to breadth and depth. In considering submissions The Institution takes into account not only the syllabus but also other factors such as the size and quality of the teaching staff and the standard of the laboratory equipment. Approved courses are reviewed at regular intervals.

Because of their great importance in the work of the professional engineer, The Institution has also taken an interest in the training of engineering technicians whose work lies in the region between the engineer and the craftsman. It considers that there should be properly organized courses of training for technicians ; that there should be uniform standards throughout Australia ; and that an independent national accrediting body should be established.

*R. E. Vowels, *Jour. I.E. Aust.*, Vol. 35, No. 9, September, 1963, p. N69.

The Institution welcomes to its ranks engineers from other countries and has taken special steps to ensure that their qualifications are objectively assessed, free from non-technical considerations, by appointing in 1948 a Foreign Qualifications Advisory Committee consisting of members who hold qualifications obtained in non-English speaking countries. Last year, when The Institution was asked to take action in dealing with the qualifications of Czecho-Slovakian engineers wishing to migrate to Australia, the Foreign Qualifications Advisory Committee was able to report quickly that 58 of the 67 inquirers would be eligible for admission to The Institution. Without any obligation to join The Institution, the successful inquirers were given letters to this effect, so enabling them to be employed as professional engineers.

PROFESSIONAL INTEGRITY

The third function of the complete professional society is the promotion and preservation of a high standard of conduct. Many leading international societies do not have a formal Code of Ethics but throughout its history The Institution has given great emphasis to this important function, and a section of the original Constitution dealt with professional conduct as applied to consulting engineers. This function is now covered by the Code of Ethics, the first Clause of which—" An Engineer's responsibility to the community shall at all times come before his responsibility to the Profession, to sectional or private interests, or to other Engineers "—sets a high, if difficult, standard and I have often heard it highly praised by members of other professions.

Complaints of breaches of the Code of Ethics are investigated carefully but most are found to be based on misunderstanding or are of a minor nature which can be dealt with by a reprimand. Rarely has drastic action been necessary.

STATUS

Millerson† considers that the three functions so far discussed are the primary ones of a professional organization and that, contrary to the general opinion, concerted action to elevate professional status is secondary. He goes on to say " Standing of a professional group must depend ultimately on the quality of service offered by the individual ; to some extent, this will depend on the association's standards. If an organization intends to gain advantages for members, success can only follow demonstrated public benefit. Ability to secure wide publicity and make a resounding impact can bring a professional group to public notice, so creating a general awareness of the group's existence. But public awareness must not be confused with public estimation ! "

From the inception of The Institution the problem of how to increase the status of the engineer has been discussed more than any other single subject. There are innumerable references to it in Presidential Addresses, in Editorials, in Letters to the Editor, in the reports of many special committees at both national and divisional level. Vigorous arguments have raged as to which comes first—status or remuneration—and as to the best means of improving status—the significance of self-employment versus salaried employment, the advantages or otherwise of engaging public relations consultants, the importance of dress, etc. etc.

For the first 15 years, great faith was placed in legal registration and licensing as a means of elevating the status of the profession and its members. It was repeatedly pointed out that medical practitioners, dentists and lawyers were all registered ; that electricians, boiler attendants and drainers were also registered was rarely if ever mentioned ! In 1922, a draft of a Registration Bill was referred by Council to the Divisions for action. In the framing of this Bill it was realized that it would be impossible to restrict the use of the word " engineer ", which by long usage in the English language has come to include craftsmen, and " Professional Engineer " was the term for which protection was sought. In spite of vigorous efforts, Queensland was the only State in which success was achieved. In 1929 an Act was passed restricting in that State the use of the terms " Professional Engineer " and " Consulting Engineer " to engineers registered by the State. Its main effects have been to safeguard those wishing to engage consulting engineers and, on the other hand, to protect consulting engineers from the use of the title by unqualified persons.

Nevertheless, the desirability of registration kept coming up, and in 1961 Council decided to study it anew. As the result of this investigation it agreed that " having examined the situation in countries where there is legal registration of engineers, and having considered the manner in which the profession in Australia is controlled by the profession itself through its Institution, (it) does not favour legal registration in Australia ".*

Undoubtedly the greatest contribution towards raising the status of The Institution, and through it of the profession and of those engaged in it, was the grant of the Royal Charter in 1938. This mark of distinction was the aim of our founders but it was not until the middle thirties that the standards and prestige of The Institution had risen sufficiently to justify the grant. The Charter gives Corporate Members the exclusive right to the term " Chartered Engineer (Australia) ", and that title, in fact, means much more than does the legal term " registered engineer ".

It is evident that there is no simple solution to the problem of improving status. The Institution undoubtedly has a most important part to play by insisting on high standards of admission and of professional conduct, and by improving the image of the engineer in the eyes of the public, but as Millerson pointed out, status ultimately depends on the quality of service offered by the individual to the community.

It is generally accepted that there is a correlation, although it may not be a particularly good one, between status and remuneration—even if there is lack of agreement as to which is the cause and which the effect. Whatever the answer, it is only natural that engineers have a keen interest in the material rewards they receive for their services.

Dating back to 1926, the interests of consulting engineers have been covered by the periodical issue by The Institution of scales of minimum fees. Since 1964, the responsibility for preparing these has been given to the Association of Consulting Engineers, Australia, which refers them to The Institution for approval.

In 1943, Council established a Status of Engineers Committee, with the initial task of investigating conditions of engagement and remuneration of engineers in salaried employment, and to obtain the necessary background information a full-time officer was appointed for two years. His work showed that the only effective way of improving the salaries and conditions of employment of engineers was the formation and registration with the Federal Conciliation and Arbitration Commission of an association of salaried professional engineers, which legally had to be completely independent of The Institution. This was endorsed by Council in 1945 and The Institution assisted in many ways (other than financial) in the formation of the Association of Professional Engineers, Australia, the membership of which is restricted to those holding academic qualifications enabling them to become Graduate Members of The Institution, and which works in close co-operation with The Institution.

As the result of action by the Association the Commission in 1961 handed down an Award which was not only of great importance to individual engineers, in that it markedly increased salaries, but also to The Institution because in effect it defined a Professional Engineer as one who is, or is eligible to be, a member of The Institution. It thus legally recognized The Institution as the qualifying body for engineers by placing on it the sole responsibility of defining the qualifications of a professional engineer.

A SPOKESMAN

The Institution frequently speaks and acts on behalf of the profession, both internationally and within Australia.

At the international level it represents Australia on the Commonwealth Engineering Conference, consisting of representatives of the professional engineering associations in the Commonwealth, and also on the recently formed World Federation of Engineering Organizations.

A specific example of action at the international level arose some years ago from the lack of recognition of certain Australian qualifications in other countries particularly in South East Asia. Vigorous representation in the right quarters resulted in a marked improvement in the position.

Within Australia, The Institution speaks and acts for the profession in many ways at both the national and at Division levels. It is constantly consulted by Commonwealth and State departments and authorities and, on occasions, Ministers make direct contact with the President. Much of this is confidential and, of course, cannot be publicised. Conversely, The Institution frequently approaches governments with requests and suggestions of a personal or technical nature. A recent example is the request to the Prime Minister and State Premiers for the implementation of proposals regarding road safety arising from a conference organized by the Victoria Division in conjunction with the Australian Post-graduate Federation in Medicine.

However, I am well aware that many members consider that this has been the least successful aspect of The Institution's functions and, broadly speaking, I agree with them. Admittedly, it is impossible for The Institution to express views that would have the unanimous approval of members, but this does not mean that we could not try harder than we have to respond to the appeals by the Duke of Edinburgh, and many others, that engineers as a body assert their interest in public affairs touching on their profession.

THE FUTURE

The Institution ends its first half century as a strong and rapidly growing body truly representative of the profession, but where do we go from here? Will The Institution still be strong, representative, and influential when it reaches its centenary? Undoubtedly, dangers lie ahead and they will need to be tackled with vision, vigour and courage.

†Millerson, G., " The Qualifying Associations ". Routledge & Kegan Paul, 1964.
*" Registration of Engineers ". *Jour. I.E. Aust.*, June, 1963, pp. N35-N43.

To my mind the most difficult problem facing us is how to provide adequately for the diverse technical needs of a profession growing rapidly in scope and in knowledge and, as a corollary, one in which a high degree of specialization has developed and will continue to develop at an ever-increasing rate.

The unwillingness, or the inability, of the existing institutions to provide for new specialities, either craft-based such as railway engineering, or science-based such as electrical engineering, was the cause of the fragmentation that has plagued the profession in the United Kingdom and the U.S.A., and which after many years of effort has now been only partly overcome in those countries. We in Australia have had recent experience of a similar kind when electronics engineers formed their own chartered institution.

At the present time specialist subjects are catered for at the regional level by Branches of Divisions, and at the national level by Technical Committees and by the Electrical and Electronics Board. New Branches and new Technical Committees are created when there is a positive demand for them from members. But the danger of relying on action starting at the " grass roots " is demonstrated by what happened with electronics engineering. Although I thought differently in the past, I am now convinced that The Institution itself must take the initiative in identifying, and providing in some way or another for, new specialities before they develop to the stage of forming their own associations.

In spite of the lack of enthusiasm shown by members some years ago, I am also satisfied that with rapidly growing membership and increasing specialization the time is near when our learned society activities must be de-centralized functionally, but integrated geographically, by establishing national " Colleges " (for the lack of a better word) in the various main branches, or perhaps sub-branches, of engineering. These Colleges would be not unlike the present Electrical and Electronics Board but would have a greater degree of independence and more authority, and would be directly represented on Council.

On a broader plane, our fiftieth anniversary appears to me to be an appropriate time to take a hard look at the Royal Charter and the Bye-laws and, if necessary, revise them to meet the needs of the future. Our Constitution is essentially the same as it was in 1919, when it was designed for a small body of less than 2000 members at a time when communications were difficult and when engineering was far simpler than it is today. Although it has served us well I think it is almost axiomatic that, in a rapidly advancing profession like engineering, a Constitution 50 years old needs up-dating.

The Institution is a living organism, and a saying attributed to Sir Julian Huxley is very pertinent—" The greatest and most precious property of life is the property of development and progressive change ".

EPILOGUE

Politically Australia became one nation 68 years ago, but a real national consciousness did not start to develop until the World War of 1914-1918. The first proposal for the amalgamation of the regional societies into one national institution, covering all branches of the profession, was made by the Western Australian Institution of Engineers in 1910, but it did not succeed because the time was not ripe, and it was not until after Anzac had emotionally united the people of our country that the appeal for unity made in 1917 by the South Australian Institute of Engineers was heeded.

Australian engineers owe an enormous debt of gratitude to the band of wise and devoted men, led by D. F. J. Harricks, who took up the challenge and who worked so vigorously and so capably on the truly engineering task of converting an idea into reality. In this year of jubilee I think we can fairly claim that their faith and hope have been substantially fulfilled and it is the responsibility, and the privilege, of those to come to complete the task so ably begun.

To finish, I would like to repeat words written by Francis Bacon 400 years ago :—

> " I hold every man a debtor to his profession, from the which as men of course do seek countenance and profit, so ought they of duty to endeavour themselves by way of amend, to be a help and ornament thereunto ".*

*Francis Bacon. Preface to " Maxims of the Law ".

Australian Engineering 1788-1969

By Prof. A. H. Corbett, M.E., B.Ed., F.I.E.Aust.*

Towards the end of the Eighteenth Century events in North America and Europe were to shatter for ever the idyllic pattern of the existence of the nomadic hunters who had roamed the Australian continent for some eighteen thousand years and maintained without significant change a social system that trained each boy to be his own engineer. The settlement of Australia had a peculiar, indeed a unique feature. In prehistoric times and throughout history countries have been invaded or occupied for the sake of something of value—food, minerals, a labour force, a market, opportunities for trade, a base from which to operate, or to escape from pressures in the homeland. Australia is the only country to have been occupied by government officers for what was at the time a normal government activity, without any suggestion of a profit motive. This has had a profound influence on the history of engineering in Australia. The first engineering works were government sponsored public works and the government has continued to this day to be a major employer of members of the profession.

COLONIAL ENGINEERS

The first fleet which sailed into Botany Bay in January, 1788, included in its complement a military engineer, Augustus Theodore Henry Alt (Ref. 1), who held a commission as Surveyor-General and was charged with responsibility to Governor Phillip for the elementary needs of the settlers for water, food, shelter, and roads. The history of Sydney, the city that has grown around the site of that first settlement, is closely interwoven with the history of its water supply. Military and Civil Engineers played their part in the development of schemes that spread from the Tank Stream to the sand hills above Botany Bay, to Prospect, and to the tributaries of the Hawkesbury River. In the 1840's Mechanical Engineers were required to provide cast iron pipes for the reticulation system and a steam pumping engine to augment the gravitational supply (Ref. 10).

Primitive roads were constructed by Alt from Dawes Point to Parramatta and later across the Blue Mountains to Bathurst: convict volunteers in 1814 under William Cox (Ref. 2) forced this road through rugged country at an average rate of four miles a week. The building of permanent bridges followed the arrival in the colony of David Lennox (Ref. 3) in 1832. His major work during a period of twelve years in New South Wales was the graceful Lansdowne Bridge which still carries heavy traffic on the Hume Highway near Parramatta. Subsequently he built a stone arch of 150 ft. span across the Yarra River, the first Princes Bridge.

Other engineering enterprises during the convict period were the grinding of grain into flour using wind, water, or human power, the recovery of salt from sea water, the salting of meat, the rendering of tallow, the casting of iron and the building of steam engines. From 1831 steam power was applied to wooden ships built from local timbers. At this time in Sydney mechanical engineering migrated from George Street to the Darling Harbour waterfront so that marine work could be undertaken (Ref. 4). During the 'twenties and 'thirties the colonial market was too small to permit of specialisation, and the larger mills and factories often produced a variety of products and their owners engaged in commercial and grazing ventures.

The refining of sugar was undertaken on Cook's River at Canterbury in 1842 and from this enterprise grew the Colonial Sugar Refining Company. During the first sixty years access to water was the most important factor in Australia's development both as a source of power and a means of transport.

In the period of complete dependence on the Colonial Office the main problems of colonial engineers were to obtain money for essential public works and approval of plans which had to be acceptable both in Australia and in London: negotiation by sailing ship required some two years for each round of correspondence. Both colonial engineers and architects were responsible direct to the Governor of the colony. When a measure of independence was granted a Municipal Council was set up in each capital city and a Department of Public Works became the constructing authority for each colonial legislature. Civil engineers became the salaried servants of these governmental bodies, and the continuing demand for their services in a rapidly developing nation has resulted in this branch of the profession becoming the strongest numerically and the most highly socialised.

Initially a Public Works Department (Ref. 5) or its equivalent was charged with responsibility for all engineering work constructed on behalf of the State, but for reasons which cannot be discussed adequately here more specialised agencies have developed in the States and in the Commonwealth. The advantages and disadvantages of this development would provide an interesting field for investigation.

In the eighteen fifties came the urge to build colonial railway systems and the discovery of gold. Private railway companies failed and the building of railway systems and rolling stock soon became a major responsibility of the newly independent colonial governments. The gold discoveries attracted labour to the diggings and rising labour costs led Governor Denison to deliver a public lecture on the advantages of mechanisation. Wealth from the gold fields both stimulated local manufacture and permitted large quantities of manufactured goods to be imported. The colonial capitals and the larger towns in the interior each had basic industries such as flour milling, brewing, canning, sawmilling, soap factories, and foundries. In the major agricultural and pastoral regions local needs were met by the invention, development and manufacture of machines made possible by the technology of that day. Meat and fish for consumption at home or for provisioning at sea could only be preserved by salting until the Dangar Brothers set up a small canning factory in Newcastle in 1847. The expectation of the profit to be gained by the export of frozen meat then led to many years of effort both in Melbourne and in Sydney to develop reliable refrigeration machines and success was achieved in 1880 (Ref. 6).

The second half of the nineteenth century saw large sums of public money spent on railways, water supply and drainage, bridges in the major cities, on harbours and rivers, and on public buildings. The first references to Australian engineering appeared in the *Minutes of Proceedings of the Institution of Civil Engineers* in 1859, and included a paper on "The Water Supply to the City of Melbourne", South Australia provided papers on "Main Roads" in 1877 and on "Railway Systems" in 1879, and in the latter year papers were published on the water supplies of Geelong and Sandhurst.

Private enterprise provided heavy engineering works to supply the needs of the public sector, and gave training and employment to mechanical engineers: P. N. Russell & Co., and Mort's Dock in Sydney, Robison Bros., H. V. McKay, and Thompson's Engineering & Pipe Co. Ltd., in Victoria, Toowoomba Foundry and Walkers Ltd., in Queensland, were founded and flourished during this period. It was unusual for a family business to survive more than fifty years: economic pressures and a weakening of the driving force of the founders left few exceptions.

ENGINEERING EDUCATION

Engineering education as we know it today first appeared in the colonies in the second half of the nineteenth century. Its desperate struggle for survival often appeared to have been lost, but public-spirited teachers such as Kernot, Warren, and Selfe, and rugged individualists amongst their students clung to the cause of theoretical plus practical education, and by the turn of the century a solid foundation had been laid for both degree and diploma courses. In Sydney evening diploma courses became firmly established and provided the only engineering education outside the University, but in Victoria it became the practice to offer both full-time day and part-time evening diploma courses (Refs. 7 and 12).

In the 'sixties and 'seventies industrial and political ferment amongst the colonists led to the formation of many organisations which included an indigenous engineering institution. James Laing signed a printed circular on 12th September, 1870, which was distributed to "leading members of the mechanical engineers and iron trades of Sydney" in which he advocated the formation of a society for the friendly interchange of opinions, ideas and knowledge. The outcome was the formation of the Engineering Association of New South Wales, which obtained an act of incorporation in 1884 (Ref. 8). The Royal Society of New South Wales which was inaugurated in 1866 also enjoyed the support of engineers, particularly of Warren, who contributed eighteen papers to its proceedings. The Sydney University Society was founded in 1895 to include staff, undergraduates and graduates, and it too published valuable papers.

In the other colonies engineers organised themselves along similar lines. For example, in 1883 the Victorian Institute of Engineers was established, followed in 1889 by the Melbourne University Engineering Society.

In Queensland a Mechanical Engineers' Association founded in 1886 was wound up as a result of a banking crisis, but a fresh start was made and after an Electrical Association was absorbed in 1911 the Queensland Institute of Engineers catered for all branches of the profession. Professor

*Professor of Engineering, University of New South Wales, Head of Department of Engineering, Royal Military College, Duntroon, A.C.T.

Hawken was its last President from 1917 to 1919. A similar body was the Northern Engineering Institute of New South Wales, which existed in Newcastle from 1889 to 1894, and from 1908 to 1919. The Electric Club of New South Wales was formed in 1891, and became the Electrical Association of New South Wales five years later. In the other States engineers were not numerous and professional institutions were not formed until after Federation.

There were only two Societies with intercolonial memberships: The Australasian Association for the Advancement of Science, which held its first meeting in Sydney in 1888, and The Australasian Institute of Mining Engineers, founded at Broken Hill in 1893.

AFTER FEDERATION

At the turn of the century when the six colonies decided to federate and thus form the Commonwealth of Australia passable roads and manual telephone networks were confined to the capital cities, steam railways varied in gauge from one colony to another, and were supplemented by ships around the coast and on the major rivers.

Two significant developments occurred immediately prior to the first World War. A small arms factory founded at Lithgow in 1912 became a reservoir of knowledge of interchangeable manufacture which was invaluable in the 'thirties. The smelting of base metals from Broken Hill provided capital for the formation of Broken Hill Pty. Ltd., which founded its iron and steel works at Newcastle and brought the plant into production in 1915 (Ref. 9).

When Australia emerged from the first World War it had an economically viable iron and steel industry for the first time, and the rapid development of the thermionic valve promised a revolution in communication, but otherwise the environment was little changed from pre-federation days.

But in men's minds there was dissatisfaction with many facets of prewar life, and engineers were moved to examine the absurdity of having one or more engineering societies in each of the States of the Commonwealth.

In addition to the societies formed in the nineteenth century others were formed prior to the first World War. The Western Australian Institution of Engineers was founded in 1909 and was the first to use the word "Institution" in its title, the founders being strongly influenced by the Institution of Civil Engineers, London. Tasmania used the same form of title when its engineers founded a local body in 1918, but South Australia formed an Institute in 1913, and the Local Government Engineers had formed an Institute with a Federal Executive and autonomous local Sections in Victoria (1912) New South Wales (1909) and Queensland (1913). The Electrical Association formed a Section in Victoria in 1905 and formed in 1914 with New South Wales a Federal Council having limited powers.

Politicians had agreed to settle their differences and to federate the separate colonies into a commonwealth when they recognised the weakness inherent in independence: engineers moved more slowly than politicians. The various colonial institutes with a numerically small membership could not speak with authority as representatives of the profession, they could not insist on proper training and experience as a prerequisite to membership, and they made no attempt to enforce rules of ethical conduct. Leading Australian engineers usually belonged to one of the London Institutions and some did not support any local society. In 1910 Peter Tait in the *Australian Mining and Engineering Review* urged the formation of an Australia-wide Engineering Institute and in the same year the newly formed Western Australian Institution wrote to the other bodies to suggest some form of amalgamation. The discussion dragged on year by year but no positive action resulted, although in 1916 Professor Hawken put before the Institute of Local Government Engineers a scheme of amalgamation, and in the following year the South Australian Institute of Engineers wrote to all other interested societies throughout the Commonwealth to suggest the holding of an interstate conference. The President of the senior body, The Engineering Association of New South Wales, D. F. J. Harricks, called a preliminary meeting of the five associations based in Sydney, and then invited delegates to a conference in Melbourne in February, 1918. Discussion during the two days of this conference showed that there was a general recognition of the need for a united high-grade Australian institution, but some delegates favoured an entirely new institution while others favoured a loose federal system which would retain the identity of the existing bodies.

Group of Delegates to Engineering Conference, Melbourne, February, 1918.

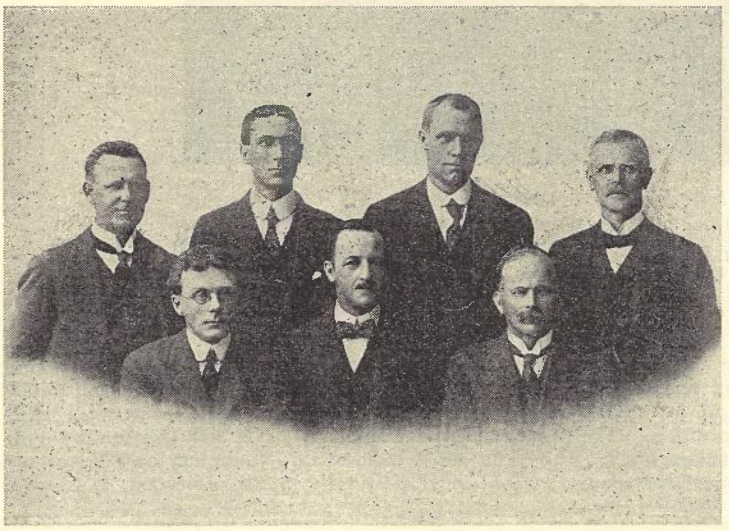
Front row: l. to r. A. Farrer, A. McCowan, Jas. A. Smith, Maurice E. Kernot, D. F. J. Harricks, A. McKinstry, G. A. Julius, Prof. R. W. Hawken, W. R. Pulver.

Second row: l. to r. A. C. Mountain, W. J. Newbigin, Geo. A. Taylor, J. G. McEwin, J. P. Tivey, T. H. Kirkpatrick, A. E. Burgess, A. S. Kenyon, H. R. Harper, J. J. C. Bradfield.

Top row: l. to r. P. G. Tait ("Commonwealth Engineer"), D. L. Stirling (Secretary), C. E. Wright, H. J. Swain, Prof. R. W. Chapman, F. Fairley (Secretary, Electrical Association of Australia, Victorian Section) J. Vicars, A. G. Jackson, A. W. Tournay-Hinge, Press Representative.

In a successful compromise the conference decided upon a union which contained features of both federation and amalgamation. The thorny problem of membership was solved by agreeing that all persons on the rolls of the associating societies were to be entitled to enrolment in the new institution, all under the age of 25 years to be classed as students and graduates, and all over 25 years to be classed as associate members. Associate members over the age of 33 years might apply to the committee of the new institution for enrolment as full member. Another resolution provided that federal control be generally restricted to federal matters and that the existing societies should as far as possible preserve their individual entities.

The provisional council of the proposed Australian Institution of Engineers met in Sydney on 15th and 16th May, 1918, when every engineering institution in the Commonwealth was represented. Harricks was elected Chairman, an office he had filled at the Melbourne conference, and he presented in outline a constitution based on the principles already accepted. During the year a committee of delegates living in Sydney produced two drafts of a constitution which was submitted by post to the interested bodies. After a number of minor corrections had been made the final draft constitution dated 13th March, 1919, was sent to each society with an invitation to become a foundation society of the new institution before 1st August, 1919. By that date twelve of the existing societies had accepted the constitution and decided to join the new body.



Sydney members of the Provisional Council who completed the proposed Constitution for The Institution, July, 1918.

Back row: *l. to r.* T. H. Kirkpatrick, H. L. Thompson, J. P. Tivey, J. Vicars.
Front row: *l. to r.* G. A. Julius, D. F. J. Harricks, J. J. C. Bradfield.

The Electrical Association of Australia had a Federal Executive, a New South Wales Section, and a Victorian Section, all of which decided to join the new institution.

The Institute of Local Government Engineers of Australasia had a Federal Executive, a New South Wales Section, a Queensland Section, and a Victorian Section, all of which decided, with the exception of the Victorian Section, to join the new institution.

Confusion has arisen because in contemporary documents a loosely federated society was recorded as one " existing society " or " foundation society " in some places, and elsewhere the individual Sections were counted. In the Constitution of the Proposed Institution of Engineers of Australia, published on 13th March, 1919, each federated society was counted only once and the total was shown as twelve " existing societies ". Counting of individual Sections appears to be the more logical method and was adopted on pages 38 and 39 of *The Transactions*, Volume I, where twelve " Foundation Societies " are listed, together with their representatives who attended the first Council Meeting of the new institution on the 20th and 21st October, 1919. The same account states that:

> ' Only three of the existing societies in Australia decided against joining. The Australasian Institute of Mining and Metallurgy, the Victorian Institute of Engineers, and the Victorian Branch of the Institute of Local Government Engineers of Australasia.' (*sic*)

Thus The Institution of Engineers, Australia, came into being with assured strength, having a Division formed from one or more foundation societies in each State of the Commonwealth, and from its foundation fully entitled to be called a National Institution.

EARLY DAYS OF THE INSTITUTION

At the first Council Meeting on 20th and 21st October, 1919, Professor W. H. Warren was elected First President for the year 1920, the Jubilee year of the oldest of the foundation societies. The Council completed the formal enrolment of members of foundation societies whose work from that time was carried on by the new institution.

In prophetic vein the founding fathers wrote: " it is impossible to conceive what possible changes will have taken place in our great Commonwealth when the time comes to record the jubilee of the greater institution, but if each one earnestly concentrates his thoughts towards strengthening in every legitimate manner the particular group to which he belongs, it can surely be hoped that, at that future date, The Institution of Engineers, Australia, will occupy as important a place in the Commonwealth structure as the parent body, the Institution of Civil Engineers, London, does in Great Britain."

In tribute to those who had given enthusiastic service to the building up of the foundation societies the names of the Presidents and Honorary Secretaries of each foundation society were recorded in the first volume of The Institution's *Transactions*.

The new institution was at that time a federation, and it was hoped that the Divisions in the various States would retain a reasonable measure of autonomy in order to continue the work of the foundation societies, while the Council and its Headquarters staff would act as a co-ordinating body. Almost immediately two problems arose, and the first of these related to administration.

Divisions were permitted by the first Constitution to make their own rules, but the difficulty of co-ordinating their activities under these circumstances quickly became apparent at Headquarters. The first set of uniform rules was approved by the Council in 1922. Over the years The Institution has followed the trend in all organisations with a federal structure, and the authority of the Council has been established by precedent in ever-widening fields.

The second problem in the early years related to publications.

The Constitution provided that the official records of technical papers and discussions would be known as *The Transactions of The Institution of Engineers, Australia*, and would be published by direction of the Council. The Council attached great importance to the quality of papers published in the *Transactions*, and this responsibility was immediately delegated to a Publications and Papers Committee which has functioned continuously to this day. Divisions also were permitted to print records of technical papers and discussions but these had to be marked to indicate that they were not official publications of The Institution.

The second Annual Report shows that this dual system of publication was unsatisfactory and uneconomical, and a special sub-committee was appointed to report on the whole question. The outcome was the waiving of their rights by Divisions under the first Constitution so that all editing and printing became the responsibility of Headquarters, and pre-prints would be run off in pamphlet form prior to presentation of papers in Divisions.

In January, 1924, a new publication, the *Quarterly Bulletin* appeared, and in the first issue three pages were devoted to the new rules for publications.

The *Quarterly Bulletin* immediately established its popularity with members and as it carried advertising was almost self-supporting. Within two years a suggestion was considered that it should be published monthly but five years were to elapse before the Council replaced it by a monthly publication, THE JOURNAL OF THE INSTITUTION OF ENGINEERS, AUSTRALIA, which incorporated the *Transactions*.

For many years THE JOURNAL was the only periodical publication of The Institution. During the second World War rationing forced a reduction in the number of annual issues from twelve to eight, and newsprint was used for non-permanent pages.

In 1958 several members of the staff of the University of Sydney suggested that two additional publications should be produced, and after considering reports from the Papers and Publications Committee and from the Finance Committee the Council approved of the proposal. THE JOURNAL was to include papers of general interest, Institution News, summaries of all papers published in the other publications, and a new feature—Technical News Items. The *Civil Engineering Transactions* were to appear half-yearly and to include only papers of civil interest. *Electrical & Mechanical Engineering Transactions* were to appear half-yearly and to include only electrical and mechanical papers. These publications were to be similar to THE JOURNAL in format and to carry advertisements. THE JOURNAL and one of the other publications were to be available to each member as a service covered by his subscription and the third publication was to be available on payment of an additional amount.

The success of this scheme and the increasing membership of The Institution led the Council to approve of a further change which took

First Meeting of the Council of The Institution, 20th October, 1919.

On the dais: l. to r. W. J. Newbigin (Vice-President), Professor W. H. Warren (President), Mr. F. W. Lawson (Vice-President).
Clockwise around the table from the end opposite the dais: W. M. Nelson, D. E. Evans, Professor R. W. H. Hawken, H. H. Dare, J. J. C. Bradfield, T. M. Carey, B. A. Smith, Professor H. Payne, J. Vicars, T. H. Kirkpatrick, D. F. J. Harricks, H. L. Thompson, Reporter, F. P. Kneeshaw, G. G. Jobbins, G. A. Julius, W. R. Pulver, F. W. Fisher, Professor R. W. Chapman, J. S. Just.

effect in 1965: separate *Electrical Engineering Transactions* were published from that time onwards and *Mechanical & Chemical Engineering Transactions* were combined. Each publication appeared twice per annum.

In addition to periodicals The Institution has published many books and pamphlets, and of these the best known is *Engineering Drawing Practice*, which first appeared as a pamphlet entitled *Mechanical Drawing Standards* in 1926, and has since been frequently revised and reprinted.

ETHICS AND STATUS

Professional Societies in recent times have accepted responsibility for regulating transactions between their members and the general public and for maintaining standards of professional courtesy between their members. The first President contributed a Code of Ethics in six simple clauses which he thought would indicate to a young engineer his proper course of conduct, would inculcate loyalty to the profession, and would

22nd Meeting of the Council, 5th March, 1925.

Back row: l. to r. J. H. Butters (Vice-President), A. W. deR. Galbraith, J. H. O. Eaton, H. G. Jenkinson, A. C. Mackenzie, M. C. Coates, A. J. Gibson, H. G. Carter, D. F. J. Harricks, C. P. Walsh (Chief Clerk).
Middle row: l. to r. M. E. Kernot, H. J. Orsben (Asst. Secretary), W. R. Pulver, R. J. Boyd, W. Poole, B. A. Smith, E. F. Gilchrist, D. N. Morison, E. S. Maclean (Secretary).
Front row: l. to r. W. J. Newbigin, Prof. R. W. Hawken (Past President), Senator J. D. Millen (Past President), G. A. Julius (President), C. E. Crocker (Vice-President), Sir Henry Barraclough, H. E. Morton.

enhance the status of the profession in the eyes of the outside world. The first Code of Ethics Standing Committee was appointed by the Council in 1923 and from that time onwards the Code has been revised and published periodically, and complaints against members of The Institution of unprofessional conduct have been investigated carefully and dealt with by the Council. Fortunately in the great majority of cases the complaint has been due to a misunderstanding and rarely has drastic action been thought necessary.

The ease with which unqualified persons can describe themselves as engineers has always been a source of concern to professional engineers, concern which in the early years of The Institution found expression in demands for Acts of Parliament in the various States providing for the registration of engineers. In the first Presidential Address, Warren said that both engineering and architecture required legal protection and quoted overseas opinion in support of his opinion. This suggestion was taken up enthusiastically in Sydney and several versions of a draft bill were prepared. Division Committees took up the cause in several States but only in Queensland was success achieved. Professor Hawken had sufficient influence with the Government to ensure the passing of a bill which set up a Registration of Engineers Board with Hawken as Chairman and prominent engineers and Corporate Members of The Institution as members. This act which became law in August, 1930, protected the titles " professional engineer " and " consulting engineer " only. Divided opinion within the profession and political opposition in the State Parliaments prevented the passing of similar acts in other States and during the 'thirties a drift in opinion away from registration was apparent, but the Council Standing Committee on Registration was reappointed annually until 1947. The question of registration has been raised spasmodically by Division Committees and the matter has been discussed in British Commonwealth Engineering Conferences, but the present Council policy is against any further attempts to obtain State registration acts.

The appointment of a Field Officer, first proposed at the end of 1943, was pushed forward vigorously in the following year and Squadron Leader E. B. Waddy took up duty on 15th January, 1945. His activity resulted in the publication of 17 reports in THE JOURNAL in 1945-46. Amongst other matters of moment to employee engineers Waddy made it clear that a separate association of professional engineers was necessary to safeguard their interests. Council endorsed this in principle and made Waddy available to assist members who wished to establish such an association. At a series of meetings in 1946 the Association of Professional Engineers, Australia, became firmly established. Its first major success came in 1961 when the Commonwealth Conciliation and Arbitration Commission handed down the first Federal award for members of the Association, and named The Institution as the qualifying body for professional engineers. The benefits of this and subsequent awards have since spread throughout professional employees in Australia.

THE ROYAL CHARTER

Many of the senior foundation members of The Institution of Engineers, Australia, were also members of the Institution of Civil Engineers in London which had obtained a Royal Charter in 1828. It is not surprising then that the first Council of the new institution favoured a proposal to obtain a Royal Charter of Incorporation. While the obstacles to the granting of a Charter were only too apparent, another Royal favour was obtained when the Prince of Wales during his visit to Australia in 1920 graciously consented to become the Patron of The Institution. In the 'thirties The Institution found in Sir Henry Barraclough the personality and the prestige necessary for the attainment of its prime objective, which required the support of all the engineering societies in Great Britain. During a visit to London in 1935 Barraclough laid the ground work for a successful application, and the petition and draft charter were approved at an Extraordinary General Meeting held at Headquarters on 25th August, 1937, the resolution being moved by Barraclough and seconded by Harricks, who had been one of the founders of The Institution. The President for that year, John Murray Crawford, M.B.E., was overseas and was able to give close personal attention to the submission of the relevant documents to the Privy Council.

The Institution had arranged for its Annual Conference in 1938 to coincide with the celebration of Australia's 150th Anniversary in Sydney. The Official opening of the Conference had been set for 28th March, but the letters patent granting the Charter were not signed and sealed until 10th March, 1938. The help of good friends in official and professional circles in London ensured that the document reached Sydney by air mail immediately prior to the opening of the Conference.

" With simple but impressive ceremony His Excellency The Lord Wakehurst, K.C.M.G., Governor of New South Wales, made the momentous announcement that His Majesty King George VI had been pleased to confer upon The Institution a mark of His Royal favour and as he handed to the President (J. M. Crawford) the Royal Charter of Incorporation, the distinguished gathering watched with hushed silence which was broken a few moments later by prolonged acclamation."

This is the opening paragraph of the official record of the receipt of the Royal Charter, an event which was to involve office-bearers of The Institution in several years of strenuous endeavour.

The Institution had been incorporated as a legal entity under the Companies Act of the State of N.S.W. on 1st May, 1926. At that time the *Objects of The Institution*, originally stated in general terms, were amplified and incorporated in the Memorandum of Association, and the original *Constitution*, with amendments and additions, became the Articles of Association.

One of the material advantages of incorporation under Royal Charter is release from the requirements of the Companies Act, which is subject to amendment at any time by the State Parliament. Before The Institution could attain this happy state the former incorporated body had to be wound up, and its assets and membership transferred to the new organisation.

The Twentieth Annual Report (in 1940) recorded that difficulty was being experienced in transferring The Institution's interest in Science House from the old body to the new, and that an amendment to the *Science House (Grant) Act* of 1928 might be necessary. The same Report recorded that:

> " Only those who have been in close contact with the work of the Constitutional Questions Standing Committee can appreciate fully the magnitude of the work involved in the preparation of drafts of the new Bye-Laws of The Institution under the Royal Charter. The amount of detail is enormous and members of the Standing Committee are required to retain in their minds a mental picture of the entire organisation and administration of The Institution as pertaining both to the Headquarters and to the Divisions."

Nevertheless these problems were overcome: the last General Meeting of the old incorporated body was convened on 7th March, 1941, and three months after that date it ceased to exist, while the Bye-Laws were approved by the Governor-General-in-Council on 21st May, 1941, and became effective immediately.

Members generally were not conscious of these protracted negotiations, but their address stencils were altered to include the title, *Chartered Engineer (Australia)*, and they were urged in the Nineteenth Annual Report to adopt this description of their occupation. The inclusion of (Australia) in the title has always been annoying to some members, and it may be of interest to record that reference to the drafts which have been preserved by The Institution shows that the phraseology was borrowed from the draft charter of the Institution of Engineers, India, which had been successful in an application for a Royal Charter some years earlier. It may be surmised that the London Institutions, whose support was vital, insisted on a distinction being made.

EXAMINATIONS

The pattern of examinations for admission to corporate membership and of recognised exempting qualifications was established by the first Constitution, and a Committee of Examiners (later the Board of Examiners) was set up to administer this requirement. The first examinations were held in March, 1922. At that time the Board was beginning to influence the revision of engineering courses and the adoption of defined standards of admission to diploma courses.

Throughout the history of The Institution this work has been continued, with a major change in policy approved by the Council in November, 1958. Up to that time students could, if they wished, take The Institution's Examinations instead of the examinations of a recognised engineering school. Thereafter admission to The Institution's Examinations was restricted to those who could show that they were unable to enroll in an ordered course of instruction leading to an exempting qualification.

In November, 1962, the Council went one step further in announcing that The Institution's examinations would not, in future, be available as a means of qualifying for the profession. The examinations are now used only to test those who have a substantial qualification but about which there is some doubt.

The Institution began to take a more detailed interest in engineering education in 1946, when the Annual Report recorded that:

> " The Council has been concerned to note that certain candidates for membership had obtained their engineering diplomas from Technical Colleges at an extremely early age—in one case at the age of sixteen, and in other cases at ages ranging from seventeen to twenty years, and it was decided that the Board (of Examiners) be asked to make an appreciation of the position. . . . "

Later in the year, in a Christmas Message from London, President T. H. Upton said:

> " Another matter about which I feel we should, as an Institution, develop clear and definite views is engineering education, so that we might play as influential and guiding a part in this as do the major Engineering Institutions of the U.K."

An Engineering Education Standing Committee of Council was appointed for the first time in 1947 and was convened by Dr. Upton until he retired from the Council at the end of 1954. The functions of this Committee were then merged with those of the Board of Examiners. The first interstate conference on Engineering Education was held on 22nd November, 1948, when all States were represented. The Board of Examiners presented the results of a review of all engineering courses in Australia, and showed that a minimum standard had been adopted for the granting of complete exemption from The Institution's examinations.

In the 'fifties and 'sixties Council policy on engineering education was increasingly influenced by discussion at international conferences, and by the Reports to the Commonwealth Government of the Murray and Martin Committees. Lively discussion at Division and Branch level also assisted in the formulation of firm policies. In 1961 Council gave ten years' notice that its minimum requirements for recognition of an engineering course as granting complete exemption would be matriculation entrance standard, and content equivalent to three years' full-time study. Discussion of the Martin Report and the improved status of engineers resulting from awards granted to the Association of Professional Engineers, Australia, led to reconsideration of the minimum length of full-time courses and this was increased to four years, with effect from 1980.

QUALIFICATIONS FOR MEMBERSHIP

In addition to a sound engineering education candidates for corporate membership were required to have adequate experience of professional work. Responsibility for interpreting the requirements of the Constitution and for reporting on each applicant was entrusted to a Qualifications for Membership Standing Committee of Council, and this body has continued its important task throughout the life of The Institution. For the checking of the claims made by applicants The Institution has always relied on the personal knowledge of its members, although this has placed difficulties in the path of newly-arrived migrants. In 1928 it was decided to publish the names of all applicants for membership in THE JOURNAL, but the practice was discontinued in 1963 when the Secretary reported to Council that it served no useful purpose.

During the past thirty years the world has seen whole populations displaced by war and political upheavals. The migrants who have come to Australia have included considerable numbers of professional engineers whose services have been most welcome. The Institution has always extended all help within its power to migrants, while ensuring that the unqualified did not compete unfairly with the qualified. " Application Forms of Strangers " were approved by the Council in 1921: references to the influx of foreign refugees first appeared in Annual Reports published in 1939 and 1940. In 1948 Council found it possible to appoint a Foreign Qualifications Advisory Committee to the Board of Examiners with members who held qualifications obtained in non-English speaking countries. While the primary role of this Committee has been to advise on foreign academic qualifications, its advice on a wide range of problems has been invaluable.

During the post-war period Australia's relationships with her Asian neighbours have been strengthened by the Colombo Plan which has enabled Asian students to study in Australian universities and technical colleges. The goodwill of those who completed engineering courses was shattered when they found that their Australian qualifications were not recognised in their homelands.

This unhappy outcome was brought to the notice of The Institution in 1953 and for the next four years the resources of The Institution were devoted to the task of securing recognition of Australian academic qualifications in engineering. Very strong support was received from Lord Casey, later Governor-General of the Commonwealth, and from Sir Edmund Herring. The Institution's efforts resulted in limited success only. The Regulations for Appointments in Her Majesty's Overseas Civil Service were amended to include membership of The Institution under certain conditions as an acceptable qualification, but these conditions excluded many members.

Although Conferences of the Engineering Institutions of the British Commonwealth have been held at four-yearly intervals since 1946 it has not been possible to formulate uniform requirements for admission between the various institutions, and an individual whose examination qualifications and experience make him acceptable as a professional engineer in one country may find himself excluded in another.

RESEARCH

The formation of an Engineering Standards Association had been an important objective of The Institution from its foundation, and it was a matter of general congratulation when on 12th October, 1922, the Commonwealth Government gazetted the appointment of the Main Committee of the body now known as the Standards Association of Australia, generally known as S.A.A.

The Headquarters of the new Association were at the Headquarters of The Institution, and Mr. E. S. Maclean was Secretary to both. It is not surprising that the Association received adequate publicity in The Institution's publications: the *Quarterly Bulletin* in October, 1925, recorded the release of the first five Tentative Specifications and the preparation of another twenty-four, and commended them to the notice of members.

Although Australia lags behind other developed countries in the proportion of its income devoted to research and development, there has been a rapid increase in the number of engineers employed full-time on research or in teaching institutions where part-time research is encouraged.

Members of The Institution played a leading part in setting up and directing the government instrumentality which has become the Commonwealth Scientific and Industrial Research Organisation. At a major conference in May, 1925, which marked a turning point in Commonwealth Government involvement in research The Institution was represented by the President, G. A. Julius (later Sir George) and the Past-President, Senator J. D. Millen. The wheel has now turned full circle and we find Victoria Division housed in the building that commemorates Clunies Ross, and his work as a research scientist, particularly his Chairmanship of C.S.I.R.O. through ten intensive years.

The Institution's internal participation in research activities began in July, 1945, when Melbourne Division Committee received a letter from C. E. Moorhouse (now Professor and Past-President) suggesting that The Institution, or its Divisions, should set up Research and Advanced Studies Committees. The outcome was the establishment of separate committees in these two fields, and the Research Sub-Committee of Melbourne Division published a Preliminary Report in December, 1947, entitled *Engineering Research Organisation and Activities with Special Reference to the State of Victoria.*

In November, 1948, the Council adopted the principle of entrusting its research interests to technical committees similar to those of the American Society of Civil Engineers.

The Technical Standing Committee was appointed in 1949 to advise the Council and to supervise specialist technical committees which it might be found expedient to appoint for the study of particular subjects. The Committee meets in Melbourne. Its first report in July, 1950, set out recommended rules for its own procedures and for the establishment of technical committees. Initially there were three: (1) Research Survey, (2) Stormwater Standards, (3) Soil Mechanics and Foundation Engineering. The latter quickly became an Australian National Committee, affiliated with an International Society, and including New Zealand engineers in its membership. In 1954 there was added No. 4: Prestressed Concrete, and in 1955 No. 5: Agricultural Engineering. In the following year No. 4 was disbanded, but No. 6: Hydrology was appointed.

The Research Survey Technical Committee published *A Survey of Australian Engineering Research* based on information collected in 1952, and in January, 1954, commenced a second survey which required two and a half years to complete. The resulting paper, *Australian Industrial Research,* 1955 was published in THE JOURNAL, Vol. 28, No. 10-11, Oct.-Nov., 1956.

In 1958, the Stormwater Standards Technical Committee completed its work by publishing a report entitled *Australian Rainfall and Runoff.*

This has been the general pattern of the activities of the technical committees which have performed a national service by collecting and disseminating information in their particular fields throughout Australia, and by providing links with appropriate international societies.

THE LEARNED SOCIETY

The Institution inherited from the foundation societies the tradition of holding regular meetings for the reading and discussion of papers written by members, of publishing selected papers and discussions, and of maintaining a library. These activities are generally referred to as the learned society function.

The practice of holding evening meetings organised either by a Division to discuss a paper of general interest, or by a Branch of a Division to discuss a paper on a specialist's topic, has continued throughout the history of The Institution, but the willingness of members to attend evening meetings is declining, and authors are increasingly unwilling to undertake the labour of preparing a major paper for presentation to an uncertain audience. At the same time there has developed an increasing demand for meetings extending over one or more days and attracting specialists from several States. Some of these meetings have been organised by Divisions and Branches, but the present practice is to entrust them to appropriate technical committees who are able to ensure that the papers are appropriate, of a high standard, and in many cases suitable for publication.

The success of these technical conferences, and the resulting pressure on the publishing resources of The Institution may be summarised by stating that the number of papers submitted for publication has increased from an average of 70 a decade ago to 290 in 1968.

The Annual Conference held in each Division in rotation has been a regular feature since 1922 when the first was in Melbourne. The Jubilee Conference was held in Sydney in April, 1969, and completed the fifth round. This series has been interrupted only by a maritime strike which cut off Hobart in 1925 and by the second world war. All but two of the meetings have been held at the location of a Division headquarters, but the two exceptions, Cairns in 1960 and Cooma (headquarters of the Snowy Mountains Authority) in 1962 have shown that the enthusiasm of a local committee will compensate for the restricted facilities of a country town.

The Annual Conferences have developed a traditional pattern, which includes functions intended to improve the public image of The Institution, the reading of technical papers and visits of engineering interest within the city or region, and both formal and informal opportunities for social exchanges between engineers with a broad spectrum of interests.

THE LIBRARY

The Engineering Association of New South Wales applied half of the income from the Peter Nicol Russell bequest to the improvement of a library that had been maintained from the early days of the Association, and on the foundation of The Institution the books, periodicals and index became the joint property of Headquarters and Sydney Division (Ref. 8).

The library has continued to provide a service to members, both personally and by post, and has a second important function as a reference source for the editorial and publishing staff. By direction of the Council expenditure on textbooks has been restricted, but many are donated for review purposes, and the strength of the library consists of periodicals which generally are received in exchange for The Institution's publications.

THE WORK OF ENGINEERS

The pattern of employment of engineers during the past fifty years has followed that established in the nineteenth century: the majority serve government, county and municipal authorities, whose activities, apart from the generation and distribution of electricity, are mainly in the fields associated with civil engineering, while those employed by companies are generally concerned with manufacture, sales and maintenance (Refs. 11 and 12). Self-employed engineers are a very small group, the majority being consulting engineers.

Engineers in private employment have been circumscribed in the writing of papers by commercial security and lack of facilities, and there is no satisfactory record of their contributions to the progress of the nation. Railways, mining, and the primary smelting of metals, with the exception of some recent papers from the staff of the Broken Hill Proprietary group, are activities on which little has been published.

Research, both in the universities and in government-supported organisations is fully-reported except when security restrictions apply. The tendency of some groups of engineers engaged in research to publish overseas rather than in Australia is being reduced, and the organising of technical conferences has been an important influence in widening the range of research papers published by The Institution.

A comprehensive record of the work of the teams of engineers employed by governmental and other public authorities is to be found in the publications of The Institution. An index of this material is at present being prepared by the library staff at Headquarters and when published will serve as a key to the recorded achievements of engineers employed in the public sector.

CONCLUSION

The present author has been commissioned by the Council to write a definitive history of The Institution, which will be in the hands of the publishers later in the year. He hopes to whet the appetite of his readers for the longer work, and in moulding this paper to the length prescribed for THE JOURNAL has of necessity selected only a few of the major issues which have been resolved by Australian engineers, particularly those who have formed The Institution during the fifty years from 1919 to 1969.

The professional engineer is essentially the servant of the society in which he lives. Those who have grown old in the Australian environment and have been members of The Institution from student days will have accepted the evolution of The Institution as a natural consequence of the pressures to which its members have been subjected, but the engineer who has migrated in the post-war years, or the member who has graduated in that period, may more readily accept the form of his Institution in its fiftieth year if he has an appreciation of the men and the forces by which it has been moulded.

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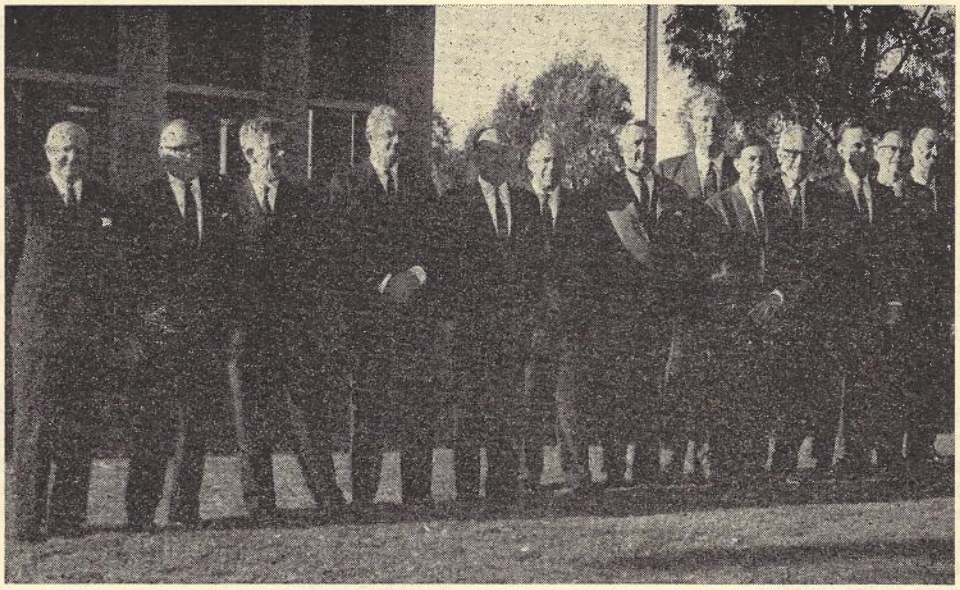
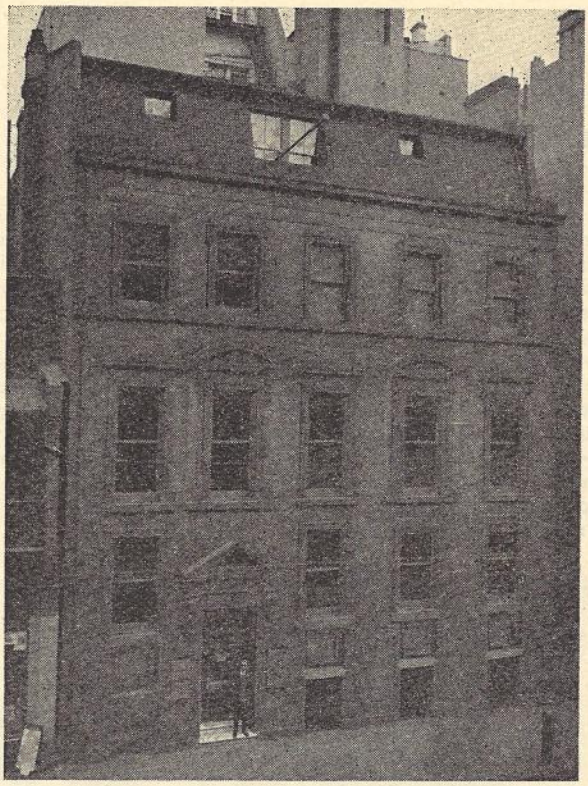


Left to right: Mr. J. M. Gosper; Professor K. L. Cooper; Mr. G. H. Vasey; Mr. R. N. Morse; Mr. G. T. Colebatch (Past President); Mr. E. J. Crawford (Past President); Mr. B. J. Callinan (Vice-President); Professor C. H. Munro; Professor G. H. Newstead; Dr. A. H. Nash; Mr. P. H. Fitchett (Chairman, Victoria Division); Mr. J. M. Antill (Chairman, Sydney Division); Mr. L. deW. Henry.

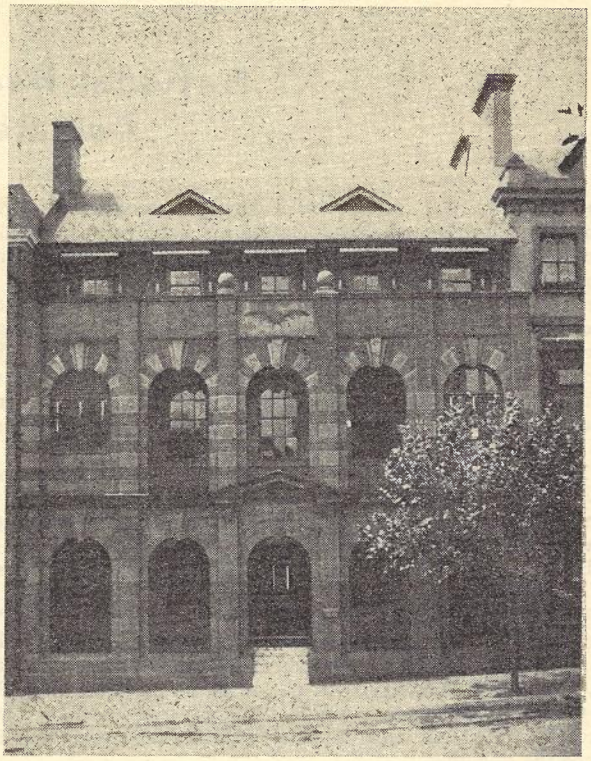
Left to right: Mr. L. G. Rowe; Sir Philip Baxter; Air-Commodore K. E. James; Mr. J. Metcalfe (Vice-President); Mr. J. C. Rivett; Mr. W. V. McKensey; Mr. H. J. N. Hodgson (Past President); Mr. F. B. Haigh (Senior Vice-President); Professor J. W. Roderick (President); Mr. C. H. D. Harper (Secretary); Mr. I. G. Cameron (Chairman, Queensland Division); Mr. R. G. Griffin; Mr. M. B. V. Anderson; Mr. S. M. Munday; Mr. M. G. Speedie.

Left to right: Mr. R. J. Jackson; Mr. R. R. Newlands; Mr. L. A. Endersbee; Mr. J. J. Edwards; Mr. D. H. Fraser; Professor M. Shaw; Professor A. H. Corbett (Vice-President); Brigadier W. F. E. Schrader; Mr. R. A. Priddle (Past President and Honorary Treasurer); Mr. D. Scott Young; Mr. H. E. Dann (Vice-President); Mr. J. A. Brodie; Professor C. E. Moorhouse (Past President).

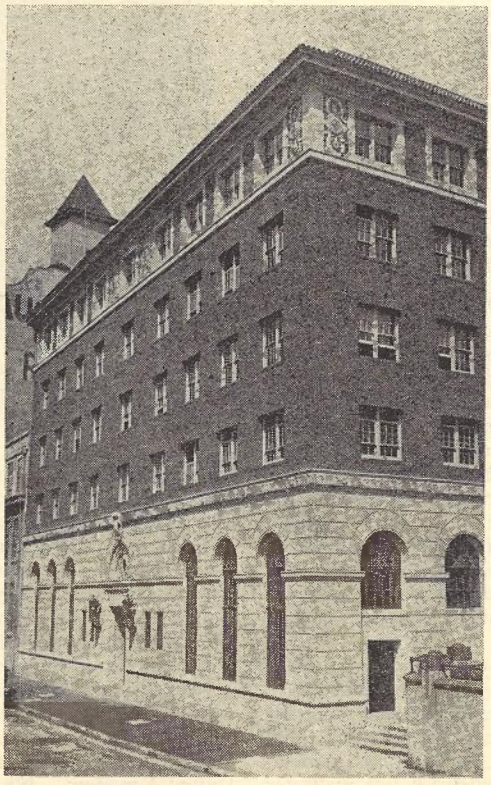
The Council Meeting, 31st July, 1969



Royal Society Building, Elizabeth Street, Sydney—Office of The Institution from 1919 *to* 1922.



Macleay House, College Street, Sydney—Office of The Institution from 1922 *to* 1931



Science House, Sydney—the Headquarters of The Institution from 1931

National Headquarters, Canberra Commemorative Stone

On 31st July, 1969, the last day of The Institution's first 50 years, the construction of its National Headquarters in Canberra was officially commenced. The symbolic act was the setting in place of a commemorative stone and plaque in what will be the forecourt of the building.

From 11.00 a.m., as the official guests arrived and took their seats they were entertained by the military band of the Royal Military College.

Between the rows of seats, suspended from a crane, hung the commemorative stone of polished granite, hexagonal in cross section, with the insignia of The Institution carved on one face. Alongside, covered with blue bunting, was the bronze plaque ready to be set into the recessed top of the stone.

The official guests included the Presidents of kindred societies, Heads of Government Departments, and representatives of the Services.

At 11.30 a.m., preceded by a motor cycle escort, Their Excellencies Sir Paul Hasluck, Governor-General of Australia, and Lady Hasluck arrived. As His Excellency stepped from the car, his standard was broken from a flag pole alongside the dais.

Their Excellencies were met by Professor J. W. Roderick, the President of The Institution, and Mrs. Roderick who presented to them the Honourable L. H. E. Bury, Minister for Labour and National Service, Mr. F. B. Haigh, Senior Vice-President, Mr. C. H. D. Harper, Secretary, Professor A. H. Corbett, Vice-President resident in Canberra, and Mrs. Corbett.

Professor Roderick then escorted His Excellency to the dais and addressed the assembly.

Your Excellencies, Mr. Minister, Distinguished Guests, Ladies and Gentlemen.—It is my very great privilege to welcome here today His Excellency the Governor-General of Australia, Sir Paul Hasluck and Her Excellency Lady Hasluck: we are, too, particularly pleased to have with us—representing the Prime Minister—the Honorable the Minister for Labour and National Service, Mr. Bury; and to all our guests here today I extend on behalf of The Institution a most cordial welcome.

For The Institution of Engineers, Australia, the 31st July, 1969, is destined to become an historic date marking—as it does—the end of the first fifty years of our professional activities. And what an eventful fifty years it has been. At the time of the formation of our Institution in 1919, we were struggling out of the age of steam, wireless telegraphy had arrived and man had at last got off the ground and learned to fly in aeroplanes so aptly referred to by many as kites. What a contrast we see as time closes on our Jubilee; atomic energy, the rocket motor, colour television and man has not only soared beyond the environs of earth, but has now navigated his ship through space to make the very recent landing on the moon.

You may like to know that last Friday the congratulations of The Institution on this historic achievement were sent to the Director of the National Aeronautics and Space Administration in these words:

> " On behalf of all engineers in Australia I extend to you heartiest congratulations on the triumphant conclusion of man's most extraordinary and significant engineering feat to date, and our warmest admiration for the brave men who undertook the mission ".

It is also of interest to note that all three of the astronauts hold degrees in engineering.

No-one can fail to experience the glow of triumph that emanates from this great venture into space made possible by a veritable army of scientists and engineers. To the scientist rightly goes the outstanding credit for the creation of new science, but it has fallen to the engineer to exploit this science in designing and constructing the vast apparatus of space travel. I have in mind the civil engineers concerned with the launching pads and towers, the mechanical engineers who developed the rocket motors, the electrical engineers responsible for power, communication and control systems, the chemical engineers who developed the life support systems and the solid fuels for the rocket motors. Nor must we forget the impressive array of engineering works in the string of tracking stations around the world and of which the giant telescope at Parkes is one of the great engineering feats of the Australian scene.

But in a comparatively new and developing country like Australia, much of our engineering in the past has of necessity been concerned with the more orthodox tasks of developing new living areas and providing the amenities for an increasing population. Across the country we see small settlements becoming sizeable towns; new harbours have had to be created, our various forms of transportation have had to be extended and our water resources and our national system of roads are being developed as fast as funds will allow. Our centres of industry are continually demanding more sources of power and hydro-electric and coal-operated stations in increasing number are contributing to this need. Business and commercial organisations are continually demanding increased and improved facilities for communication, to say nothing of data processing and other computer facilities. It is no wonder that the engineering profession has for many years been fully committed to these tasks alone.

As a small nation we cannot expect to be in the forefront of such expensive ventures as space travel, which demand engineering research and development of the highest order. But we must be alive to the application of the new science emanating from it—or " spin off " as our American friends call it—as for instance the processes for producing micro-circuitry for electronic devices, the development of steels of phenomenal strength for rocket cases, and of ceramic materials with amazing heat resistant properties to mention only a few examples.

Their Excellencies Arrive at the Site.

Left to right : Lady Hasluck, Mrs. Roderick, Sir Paul Hasluck, Professor J. W. Roderick (partly obscured), The Honourable L. H. E. Bury, Mr. F. B. Haigh, Mr. C. H. D. Harper, Professor A. H. Corbett, Mrs. Corbett.

In the next fifty years of engineering it is reasonable to expect that the progress to be made will be far more exciting, startling and even awesome than in the past fifty years. We should therefore ask ourselves whether we can afford to go forward as in the past relying for progress to a large extent upon the vicissitudes of supply and demand. While there are those who abhor any constraint upon technological development, there would seem to be justification for some national guide-lines in this area. From the United Kingdom comes the warning of young people forsaking the Sciences for the Arts; and the fear that the benefits of technological development will be slow in coming, because of lack of manpower adequately educated and trained for the task. And what of the Australian scene? We have precious few statistics on which we can judge our own situation but the indication is that it is no better—and possibly worse—than in the United Kingdom. We have no Ministry of Technology to worry about the problem—we have sadly few professionally qualified engineers at the decision-making level in Government; and where can the industrialist

lay his hand on an authoritative Government Report on technological manpower? Is it not time that the Federal Government called upon the professional bodies concerned to contribute to the task of preparing the information on which national guide-lines on technological manpower might be based?

However, we must press on with the task of developing the amenities of the country; we are embarking upon a programme of producing nuclear power and we have vast mineral resources which will bring in their train a whole range of new industries. But we need to know the likely demands for engineers of all kinds and how these numbers compare with the real needs of each section of the profession and industry. Only when we have some acceptable assessment of this situation can guidance be given to educational establishments to ensure an orderly development of their facilities for educating engineers. The number of young people likely to embark upon tertiary education can be forcast within reasonable limits, but the concern is for their distribution among the various disciplines. It may well be that if more information were available and reasonable incentives were provided, more young people—and particularly young women—could be attracted to those fields in which the needs of the nation are greatest.

Engineering education is a subject beyond the limits of the present occasion, but I must pay tribute to what governments have achieved in expanding our university engineering schools and creating new institutes of technology. These will no doubt provide adequately for some time to come for the initial education of engineers; but it must be emphasised that as yet there is no clear policy—and certainly no direct funding—for the development of graduate schools in engineering—those institutions where those eager to engage in research can explore new ideas and methods, can train others in those methods and, equally important, can pass on new knowledge by formal teaching to practising engineers. In an era when so much new science is ripe for exploitation, the development of our graduate schools of engineering should not for much longer be left largely to chance.

New science, expanding knowledge will lead to new branches of engineering and so we grow; indeed if we increase no faster than at present, our membership of 23,000 could become 100,000 by the turn of the century. We will come into closer contact with the community and engineering will pose greater problems for governments. We are indeed a national body and it is most appropriate that we—like other professional bodies—should be drawn to the National Capital so that we may also be seen to be truly national. In this way our communications with other national organisations and government agencies will become more personal and our communication with our members better informed. And as to the future, I am confident that those looking back upon our record will applaud our actions.

It is indeed a great pleasure to have with us today, the Honourable the Minister for Labour and National Service, Mr. Bury. He has, I know, a great deal of sympathy for the problems which beset an Institution such as ours—indeed we have a long association with his Department in advising upon the acceptability of engineering qualifications of migrants and the Department has been most successful in finding suitable appointments for engineers from overseas.

Mr. Bury has paid The Institution the compliment of joining with us on other special occasions and we are delighted to have him with us today to represent the Prime Minister at this ceremony to commemorate our Jubilee and the inauguration of our National Headquarters in Canberra.

I now have very much pleasure in inviting Mr. Bury to address us.

Address by the Honourable L. H. E. Bury:

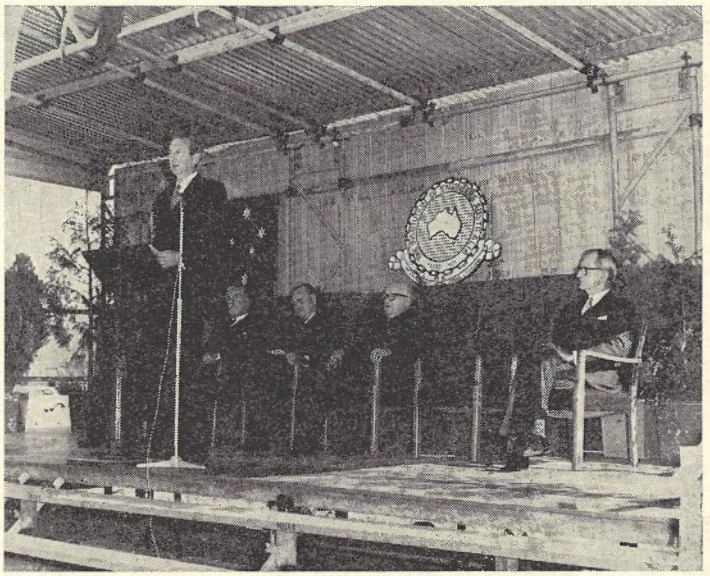
Your Excellencies, Mr. President, Ladies and Gentlemen.—It is a happy coincidence that the Prime Minister should have asked me to represent him at this ceremony today, because only in April I had the honour and pleasure of opening the Jubilee Conference of this Institution which was indeed a most highly organised and impressive occasion.

It is very fitting that The Institution should follow up its fiftieth anniversary celebrations so closely with the laying of a commemorative stone for its projected new National Headquarters, in our Capital. It is, I understand, Australia's largest professional body, and as such it is setting a most appropriate pattern for other such bodies to follow.

It is perhaps fitting too, that the Headquarters should be adjacent to the Associated Chambers of Manufactures, which serves to remind us of the very large number of engineers who are engaged in developing, expanding and running Australian industry. Many of these are production engineers who, even if they have complaints about the reluctance of some of their colleagues to give them fitting professional recognition, are among the key people of the modern world as the Americans so fully recognise.

I note also that this building has been designed by the Sydney firm of Bunning and Madden, who have already made a remarkable imprint upon the Canberra scene. As you know, they are also responsible for the design of the National Library. We can feel very confident that this new building will be not only technically efficient and a suitable home for The Institution of Engineers, but also a notable addition to the Canberra landscape.

This audience is naturally well versed in the tremendous contribution which professional engineers have made and continue to make in our national development. Statistics alone cannot tell the story, but it is interesting to note that there are at present approximately twenty-five to twenty-six thousand qualified engineers in Australia. New University enrolments last year in engineering and related faculties totalled 2,164. Total enrolments were over 7,600. Technical college details are not available but these train some of the best and most successful engineers and their output is only slightly less than half of the total output of engineers. Last year this amounted to about 1,800. Although some of these were trained for overseas countries, we enjoy a considerable intake of overseas-trained engineers into Australia.



The Honourable L. H. E. Bury Addressing the Gathering.

However, considering the importance of science, technology and engineering to our national life, all is not well. For some reason there has recently been, in Britain as well as in Australia, a trend away from science and technology which seems sadly out of keeping with the pattern of our economic life and the way in which it is likely to develop. In 1962, 14,500 new undergraduates registered in Australia, of whom 46.6% enrolled in science and 53.4% in Arts courses. In 1967, however, when 20,000 new undergraduates registered, the percentage in science courses had fallen to 37.6% and had risen to 62.4% in Arts courses. As one whose occupation it is to watch trends in the work force every closely, I cannot resist feeling that our current academic training efforts are lopsided relative to future requirements. It is not easy to discern the reasons for the trend. Perhaps it is that relatively fewer of our young people are prepared for the application of hard thought and the rigorous mental discipline and precision required for scientific subjects, as distinct from the more free and easy ways and often sloppier thought processes of the liberal arts. No doubt, Mr. President, you and your members have given considerable thought to the important subject of educating your successors.

Just recently our minds have been much focused on the triumph of science and engineering in landing men on the moon and bringing them safely home. Although from one point of view sophisticated gentlemen may write this down as the mere application of fundamental knowledge acquired some time ago, it was an incredible demonstration of accuracy, discipline and precision. It gives all engineers an ideal to strive for which may be summed up in the phrase "zero error". Into this moon venture was injected the spirit of perfection. It was a victory of the spirit as well as of knowledge. A recent article which appeared in a United States newspaper made the valid point that now it has been demonstrated what engineers at their best can achieve, it would be wonderful if the same dedication, talent and accuracy could be applied to the everyday products of industry and construction which mankind uses in immense quantities. If, for example, such a complicated series of functions can be made to work perfectly throughout the time involved, why should motor cars, electrical goods, even roads and buildings often fail us after a relatively short time.

No doubt such accuracy and workmanship would be difficult to achieve every day when so many more people are involved, but the achievement does point up an ideal for which all engineers could well continuously strive.

This recent triumph of scientists and engineers should remind us too that such results are only achieved by the faithful team work of large numbers

of people working together as a team. Good results can only be achieved by people. Relations with people therefore are vital to any sizeable project. Yet despite the tremendous effort and care applied to the materialistic factors involved, ways and means of eliciting the best and most enthusiastic contribution from subordinate members of the team involved is sometimes sadly neglected.

It is indeed to be hoped that this Institution will never overlook the human factor and do what it can to promote better relations and team work among all those involved in engineering projects. It sometimes seems that we continue to apply habits of thought towards human industrial relations which were evolved in the very different conditions and human attitudes which applied in the past. Both from the selfish point of view of all sides of industry and an enlightened national outlook, good industrial relations make or mar successful operations. It would be unfortunate indeed if we allowed the handling of the human factor to lag behind developing national knowledge. If we could succeed generally in realising our full human potential we could certainly advance our national income and economic development at a far greater pace than we now achieve.

Industrial relations, all too often, are thought of in terms of disputes and disagreements. Perhaps because this is what attracts most attention from the mass media. In fact the most important aspect is the positive side, that of motivation to encourage management, subordinates and the whole work force to give their best and think positively. I feel sure that in the new home of professional engineers that modern management techniques and good industrial relations are facets that will always be to the fore.

Finally, Mr. President, I should like to pay tribute to what always seems to me your very large measure of knowledge and enthusiasm, which has done so much to make this a notable year and landmark for The Institution of Engineers. The Prime Minister would want me to wish you and The Institution the very best success in carrying out this considerable undertaking to which you have now turned your hand.

Professor Roderick:

And now may I say how very much I as President and my Council appreciate the honour His Excellency Sir Paul Hasluck, Governor-General of Australia, has accorded to The Institution of Engineers, Australia, in accepting our invitation to conduct this simple ceremony marking our jubilee and the inauguration of our future National Headquarters. We are, too, delighted that Her Excellency Lady Hasluck agreed to accompany you. I am sure, Sir, that with your background as a distinguished politician, you will be seized with the significance of engineering in the future development of Australia and of our needs as an Institution to express our opinions and offer our advice to governments; as an academic and as a distinguished historian you will appreciate the deeper meaning—and possibly sentiment—of our wish to establish our Headquarters in the Capital. We thank your excellencies most sincerely for the honour you have conferred upon us by your presence here today and I now have great pleasure in inviting you, Sir, to address us and later to lay the commemorative stone and unveil the plaque.

Address by His Excellency Sir Paul Hasluck, G.C.M.G., K.St.J.:

Mr. President, Mr. Minister, Distinguished Guests, Ladies and Gentlemen.

I should like to thank Professor Roderick for his welcome and to assure him that it is both a personal pleasure and a privilege for my wife and myself to be here and to take part in this ceremony. I should like to compliment Professor Roderick if I may on the address he gave.

It relieves me of a very great burden because he spoke with great knowledge and with great authority of the character of the engineering profession, of the work of The Institution and of the place of engineering in the world today. With great humility, the humility of comparative ignorance, I would like to say simply how fully I endorse and appreciate everything that he did say.

I suppose there is no-one here present today who knows less about engineering than I do, but like most people who have very little knowledge, I have some terrific prejudices, and like most people who have prejudices, I will insist on expressing them, but my prejudices are also tempered with a very high admiration of what engineers do, and some very high hopes of what engineers may still do in the years to come, and so I may express chiefly admiration and hopes, and perhaps a few prejudices.

First for the admiration, one thing that I admire engineers for perhaps more than anything else, is the way they bluff the rest of the community. They seem to have got everyone else bluffed. It is enough to say today this is a magnificent feat of engineering and everyone will say, without question, it was something that was worth doing. Contrast with that, the unhappy position of say a philosopher. A philosopher might say that such an such a human action is a noble action, he may say that such and such a line of thinking is clearly reasoned and logical, but if he did venture to say that in public he would immediately be derided as an impossible old square, who was setting himself up to know more than the common man, and yet in his way, I suppose, a philosopher is just as expert on thinking, as engineers are expert on engineering. Yet somehow or other you engineers have got away with it.

I also admire the boldness of the engineer, and of course his boldness pays dividends. It is enough for an engineer to say we must think big and everyone gives him the character of a statesman. If he builds something that is big, they give him a certificate to make pronouncements on any subject under the sun. But let us assume that someone, let us say someone in the Treasury, were to say let us think big, he is immediately suspected of the wildest extravagances and of inflationary tendencies. Perhaps the illustration I have chosen is not a very happy one because while engineers often say we must think big, somehow or other those in charge of the money very seldom use those words.

One thing that I do admire, and admire very sincerely, are your works. Of course, I think engineers have the peculiar facility of being able to build their own monuments to their own design at other people's expense. And what magnificent monuments they are. As we go around the land and see the roads, the bridges, the railways, the harbours, the giant water schemes, the great buildings, the great plant and equipment that serves industry, the great machines that are working for us, we see evidences and we benefit from them every day of our lives. They do evoke the most sincere and well-deserved admiration for what the engineer does.

Perhaps that is enough of admiration coupled with the fact that I have completely endorsed all that your President has said.

What are my hopes, my hopes about the other things that engineers still might do? I am afraid I am not thinking much of the glamour girls of the profession, I am thinking rather of the maids of all work and I come down from the celestial realms to this rather humble little planet on which we live, and the tasks I would like to see engineers succeed in, in the near future, and those which I hope they will succeed in are comparatively small. One thing I would like to see them do is something on the side of housing, something that would reduce the labour cost in building the ordinary domestic residence. If there is any one in Australia who can cut a further $2,000 off the cost of a $10,000 house he will be one of the biggest social benefactors to the coming generation. I don't know how you are to do it, but over to the engineer.

Another thing I would like to see engineers do is to see if they could find a substitute for the motor car in transporting people from place to place in the heart of our great city, something that is not so noisy as the motor car, something that is less smelly, something that does not occupy so much of the road space, something that does not need vast parking areas, something that does not breed arrogance in everyone who sits in it, something that does not go around killing people but just shifts people from place to place. It is no use your saying why not try walking; that's not engineering; that's just common sense; and again I say, over to you engineer.

Other things I would like to see happen are some works for the nation and I think again of the immediate economic necessities of our national life. The great national need for more water at lower cost. I know it is within the present capacity of almost anyone present to provide more water at any cost, but water is one of those minerals that is only valuable if it is cheap, and the problem, I think, before the Australian engineer, is more water at lower cost. We need safer roads, we need improved and cheaper transport, we need better facilities for the handling of materials and commodities, we need ways of tackling still further the cost of production, both on the farm and in the factory. These are the immediate economic necessities that touch the very livelihood and comfort of our people. Humble tasks but perhaps in some ways more difficult to master than even a flight to the moon.

Now I come to my prejudices, and I assure you I won't over-emphasise them. The first prejudice I have is one I hope very much that every engineer present will share, and it is a belief, if I can elevate a prejudice into a faith, that engineers see themselves as servants and not masters of the community. I suppose that means that engineering is not an end in itself. It is serving the purposes of society. Perhaps somewhere in the laboratory there is room for pure engineering in the sense that it is experimental or engaged in speculative enterprises, and I would readily admit that there is possibly a place for engineering to become an end in itself insofar as it enters into the processes of the production of modern sculpture by mangling bicycles under rock hammers. But apart from that, in the larger part of engineering, it is not an end in itself; it is serving the purposes of society, and this leads me to another prejudice which I hold very strongly. It means that in making a test of whether engineering is good or bad engineering, you not only apply the technical judgments and the technical tests, but apply the social tests, and I will give you an illustration of what I mean. In a city, a rapidly expanding city, not very far from where we are today, in a particular part of this city they have undertaken what has turned out to be a triumph of highway engineering. The building of an overpass and underpass and traffic exchange, and something of which the people who did it

can be proud. But in that particular part of the city there used to be a lovely little hill, a slope rising gracefully to an eminence that gave distinction to that part of the city. It has been obliterated and instead of seeing that lovely little hill now you see the highway. You see the triumph of engineering, but I mourn for the obliteration of that lovely hill, and I wonder whether it was necessary. My point is not to pass idle criticism. It is just to say this—it is not enough to say this is a perfect piece of engineering, one had to think of the other tests of judgment as well.

Another prejudice I have about engineers concerns their materials, and your President was gracious enough to refer to me as a historian, so perhaps I will be forgiven for taking my illustration from a long way back and remind you of the Gothic Cathedral. The Gothic arch was a great feat of engineering considering the appliances and the knowledge they had when they built it. The Gothic arch was built of stone. It looked like stone but it showed a great mastery of the builder over his materials; he made the materials subject to his will. Nowadays we do our building in concrete and steel and undoubtedly they are good materials, but so often when one looks at the completed job, a layman, like myself, gets the impression that the materials have taken charge, that the engineer has not really been master of them; the materials have made him do what they felt was easiest to do or what was the easiest for the materials to do.

You technical men may of course say you have got to work with your materials, you are subject to the limitations of your materials. I still have this stupid prejudice that men and engineers can master their materials.

Well, Mr. President and Ladies and Gentlemen, you have been very patient and very courteous in bearing with my ignorance and suffering my prejudices. As you have detected, like anyone else who has prejudices, I have enjoyed stating them. I now come to a happier part of my duty here today and it is to express congratulations to The Institution of having achieved its Jubilee and to compliment all those, both in the past and in the present, who have worked as members of The Institution to build up professional standards in this country to safeguard the honour and the progress of the profession and in doing so to make such a notable contribution to the advancement of our nation.

In the development of our resources, in the improvement of the way of living of the people of this country, the engineers have played a notable part, and one could not use excessive language in acknowledging this and in paying tribute to them.

I am sensible that this is a very great day for all engineers in all parts of Australia both because of the Jubilee and because this is the beginning of the establishment of a national headquarters in the National Capital.

There are few occasions in which I would more happily participate and as I set this commemorative stone the thought in my mind will be one of good wishes to all engineers in all parts of Australia that they may continue to find in their chosen profession the opportunities to use their talents and their training to the full and in so doing still further to serve the welfare of the Australian nation.

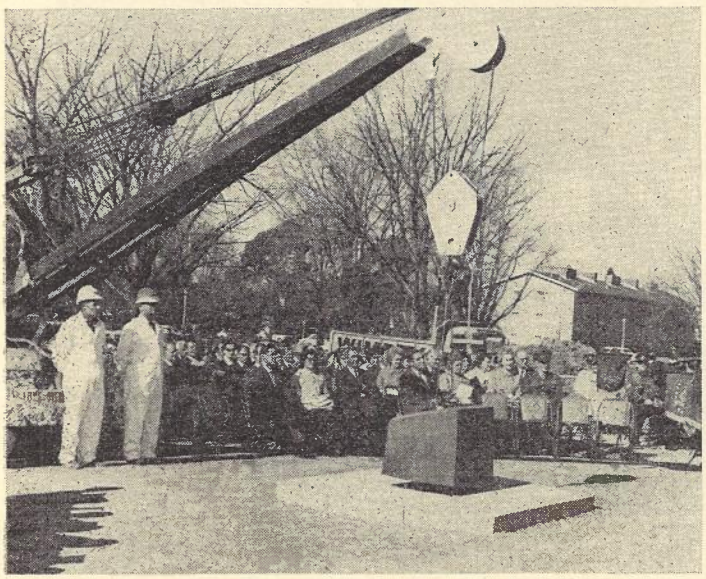
Setting of the Stone:

His Excellency and Professor Roderick moved from the dais to the suspended stone when, at a signal from His Excellency, the stone was lowered into position. Following this His Excellency unveiled the plaque which was then placed in position on the stone by officers of the contracting company.

Mr. Haigh, on behalf of the Council of The Institution and those present, expressed appreciation to His Excellency and Mr. Bury for their addresses.

Following the ceremony Their Excellencies and the official guests were entertained at a buffet luncheon at the Hotel Canberra.

The function and luncheon were arranged by Eric White Associates Pty. Ltd., the site arrangements being under the direction of Professor A. H. Corbett. The dais was erected by the contractor, George Wimpey and Co. Ltd. The stone and plaque were designed by the architects for the building, Messrs. Bunning and Madden.



The Commemorative Stone Ready to be Set.

His Excellency Sets the Stone.

(Commemorative Stone and Plaque illustrated on next page.)

The Commemorative Stone and Plaque.

The wording on the plaque is as follows:—

ON 31st JULY 1969
THIS STONE COMMEMORATING
THE JUBILEE AND INAUGURATING
THE NATIONAL HEADQUARTERS OF
THE INSTITUTION OF ENGINEERS AUSTRALIA
WAS UNVEILED BY
HIS EXCELLENCY THE RIGHT HONOURABLE
SIR PAUL HASLUCK G.C.M.G., K.St.J.,
GOVERNOR-GENERAL OF THE
COMMONWEALTH OF AUSTRALIA

Jubilee Engineering Conference, Sydney, 1969

(14th to 18th April, 1969)

The Council having directed that no effort should be spared to ensure the success of the Jubilee Conference, the Sydney Organising Committee accepted its responsibilities with enthusiasm. The members of the Committee headed sub-committees on which more than 300 members worked consistently for nearly two years.

Only those who were closely associated with this team of workers could appreciate the enormous amount of time that had to be devoted to the detailed work, particularly in the last few months before the Conference.

It has often been suggested that The Institution should employ full time staff for the organisation of its Annual Conferences, but apart from the cost of a sufficiently large team, a body of paid workers could hardly be expected to work for such long hours and with such devotion as those who had such a personal interest in the success of their efforts. It was inevitable that with such organisation the Jubilee Conference should have been the success it was.

This was the first occasion on which an Institution Conference had been held wholly within a convention centre. The Wentworth Hotel with its flexible facilities was able to cope with quick changes from several meeting rooms set up for the delivery of papers to a full-scale banquet. Such quick changes in accommodation requirements, placed great stresses on the organisers of the individual functions, but if there were any hitches those who attended were not aware of them.

The Institution had as special guests from overseas distinguished representatives of sister Institutions:

Ceylon	Mr. A. N. S. Kulasinghe President, The Institution of Engineers, Ceylon.
India	Shri. T. R. Gupta President, The Institution of Engineers, India.
Malaysia	Mr. Thean Lip Thong Past President, The Institution of Engineers (Malaysia).
New Zealand	Mr. J. C. North President, The New Zealand Institution of Engineers.
Singapore	Mr. Hiew Siew Nam President, The Institution of Engineers, Singapore.
United Kingdom	Sir Hubert Shirley-Smith Member of Board of Council of Engineering Institutions.

It was greatly regretted that Mr. H. J. Asar, President of The Institute of Engineers, Pakistan, was prevented at the last moment from attending but his message of greetings and good wishes was warmly received.

The total number of registrants was 938, which included 590 members and 348 ladies and visitors. From Sydney Division there were 494 registrants including 320 members, and from other Divisions and from overseas 444 registrants, including 270 members.

Conference Organising Committee

M. B. V. Anderson	—Conference Chairman
J. M. Antill	—Conference Organiser
S. M. Munday	—Deputy Chairman
J. C. V. Andersen	—Assistant Organiser
J. D. Hodgson	—Publicity, Brochures and Printing
R. G. Griffin	—Special Functions and Liaison Officer
D. Campbell-Allen	—Papers and Discussions
S. B. Cheeseman	—Hotel Wentworth
M. S. Nicklin	—Finance and Registration
A. H. Gray	—Main Functions
N. G. Klamus	—Local Technical and Sightseeing Tours
R. E. Johnston	—Transport
J. A. Brodie	—Pre- and Post-Conference Tours
J. A. Rankine	—Hospitality
Mrs. M. B. V. Anderson	—Ladies' Functions
S. B. Cheeseman	—Conference Secretary
H. Scholer	—Engineering Exhibitions

Official Representatives.

The following were welcomed as representatives of the various Commonwealth and State Governments and educational authorities.—

Commonwealth Government:

Mr. F. G. Blight, Weapons Reasearch Establishment
Mr. J. W. Crompton, Weapons Research Establishment
Mr. E. B. Davis, Weapons Research Establishment
Mr. J. J. W. Gray, Commonwealth Department of Works
Captain G. P. Hood, Department of Navy
Dr. F. H. Hooke, Aeronautical Research Laboratory
Air Commodore K. E. James, Department of Air
Mr. T. S. Keeble, Aeronautical Research Laboratory
Mr. J. E. H. Lamprey, Weapons Research Establishment
Mr. T. F. C. Lawrence, Department of Supply
Wing Commander J. D. G. Lessels, Department of Air
Mr. E. A. Petersons, Department of Interior
Mr. R. E. Spielrein, Repatriation Department
Wing Commander K. Therkelsen, Department of Air
Mr. R. E. E. Todd, Department of Navy
Mr. H. C. Williams, Commonwealth Department of Works
Dr. M. W. Woods, Weapons Research Establishment

New South Wales Government and Other Bodies:

Mr. F. C. Cook, Department of Main Roads
Mr. T. M. Coulter, Department of Main Roads
Mr. D. E. Davidson, Conservation Authority of New South Wales
Mr. G. V. Fawkner, Department of Main Roads
Mr. K. C. Fraser, Electricity Commission of New South Wales
Mr. W. A. Hay, Metropolitan Water, Sewerage and Drainage Board
Mr. E. H. Hughes, Electricity Authority of New South Wales
Mr. R. E. Johnston, Department of Main Roads
Professor J. W. Roderick, University of Sydney
Mr. B. J. Sexton, Department of Main Roads
Mr. J. A. L. Shaw, City of Sydney
Mr. H. G. Sweet, Metropolitan Water, Sewerage and Drainage Board
Mr. J. M. Wallace, Maritime Services Board of New South Wales

Queensland Government and Other Bodies:

Mr. K. Dawson, Department of Electricity Supply
Mr. G. E. McDowell, Land Administration Commission
Mr. V. E. Schmidt, Department of Local Government
Mr. E. M. Shepherd, Department of Co-ordinator General of Public Works
Mr. B. G. Tyrrell, Department of Harbours and Marine

South Australian Government and Other Bodies:

Mr. H. L. Beaney, Engineering and Water Supply Department
Professor F. B. Bull, University of Adelaide
Mr. S. Carapetis, Highways and Local Government Department
Mr. N. C. Cox, Engineering and Water Supply Department
Mr. O. Dennis, Highways and Local Government Department
Mr. M. R. Doig, Public Buildings Department
Mr. N. R. Griffin, South Australian Housing Trust
Mr. J. V. Kmitas, Public Buildings Department
Mr. J. S. Lapidge, Electricity Trust of South Australia
Mr. C. E. D. O'Malley, Department of Marine and Harbours
Mr. W. R. Mitchell, Engineering and Water Supply Department
Mr. D. M. Pickering, Department of Marine and Harbours
Mr. E. J. Symons, Electricity Trust of South Australia
Mr. G. H. Walker, Public Buildings Department

Tasmanian Government and Other Bodies:

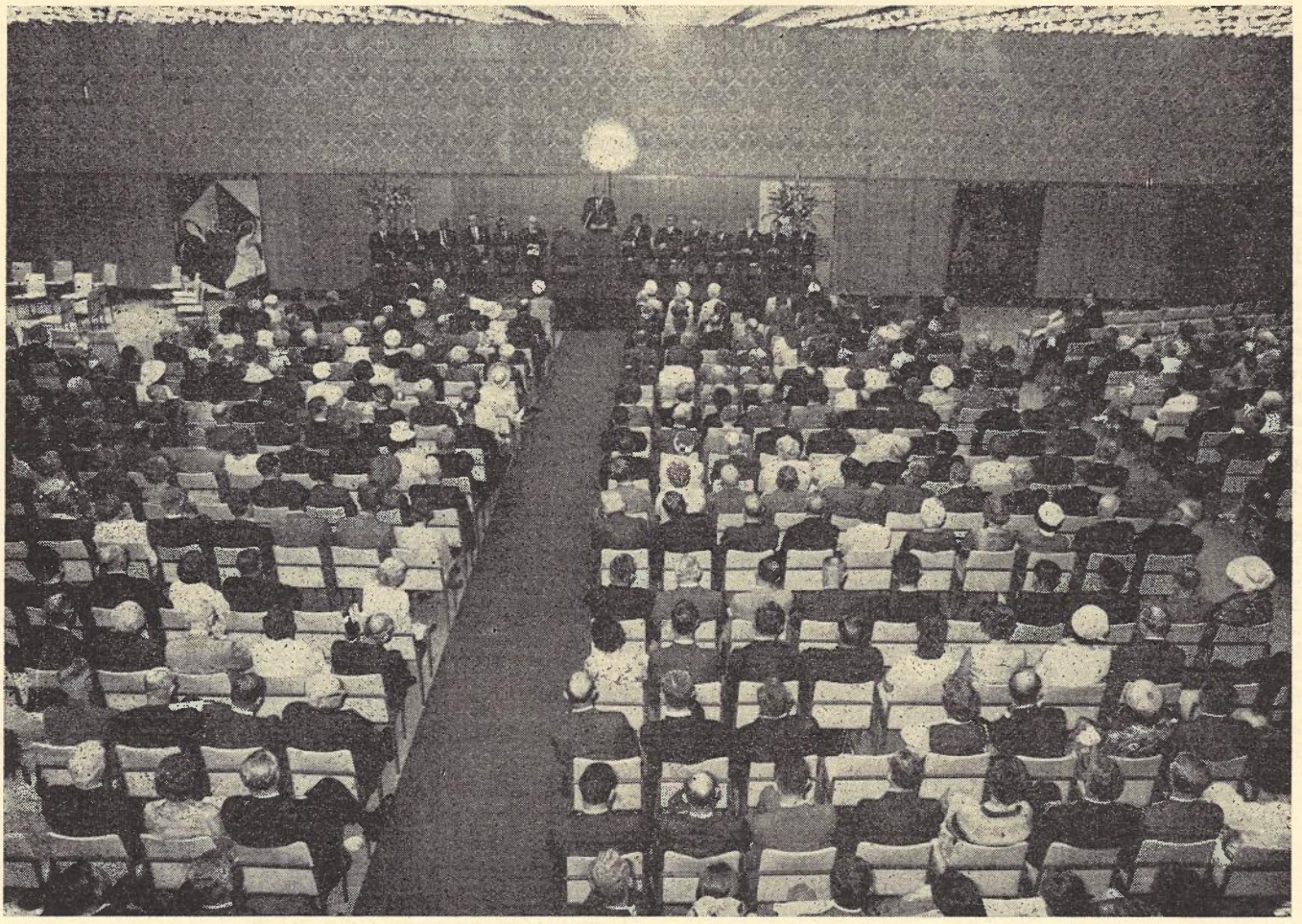
Professor A. R. Oliver, University of Tasmania
Mr. R. J. Smith, Department of Public Works

Victorian Government and Other Bodies:

Mr. D. P. Barkley, Public Works Department
Mr. G. F. Brown, Victorian Railways
Mr. R. T. Gay, Soil Conservation Authority
Mr. W. J. Goodall, Local Government Department
Professor M. E. Hargreaves, University of Melbourne
Mr. R. A. Horsfall, State Rivers and Water Supply Commission
Mr. F. R. Kirby, Melbourne and Metropolitan Tramways Board
Mr. J. Mendleson, Ministry of Fuel and Power
Mr. I. J. O'Donnell, Country Roads Board
Mr. R. G. Ritchie, Education Department
Mr. A. A. Strempel, Traffic Commission.

Western Australian Government and Other Bodies:

Mr. D. H. Aitken, Department of Main Roads
Mr. K. G. Bott, City of Fremantle



The Official Opening—Mr. M. B. V. Anderson, Conference Chairman, welcoming Guests.

Mr. W. B. C. Britten, Railways Department
Professor K. L. Cooper, University of Western Australia
Mr. W. J. Gillies, State Electricity Commission
Mr. H. E. Hunt, Public Works Department
Mr. J. R. Knott, Shire of Perth

TECHNICAL PAPERS.

The following papers which were preprinted and distributed to those who registered, and which will be published in THE JOURNAL or one of the *Transactions*, together with discussion contributed, were presented.—

Two Decades of Engineering—The Snowy Mountains Scheme, by H. E. Dann, C.B.E., B.Mech.E., F.I.E.Aust.

Signalling—The Nervous System of the Telephone Switching Organism, by L. M. Wright, B.Sc., M.I.E.Aust., and B. J. Feenaghty, B.E., M.Eng.Sc., M.I.E.Aust.

A Review of Developments in Underground Balanced Pair Telecommunication Cable in Australia Since 1945, by A. W. Sisson, Grad.I.E. Aust. and C. F. Bennett, B.Met.E., M.I.E.Aust.

Some Modern Prosthetic and Orthotic Trends and Developments Seen as a Challenge to the Engineering Profession, by R. E. Spielrein, M.I.E.Aust.

Aspects of Automatic Control in Modern Power Systems, by H. C. Harrison, B.E.E.

Protection and Control Scheme Design for the Victorian 500-*kV Network*, by K. Connelly.

Relay Protection in Hydro-Electric Power Stations of the Snowy Mountains Authority, by C. W. Walker, M.I.E.Aust.

Protection of The Electricity Commission's Transmission System in New South Wales, by K. F. Sayers, M.I.E.Aust., G. Varga, M.I.E. Aust. and A. J. Polson.

The Development of Rural Water Supply in New South Wales, by A. F. Reddoch, F.I.E.Aust.

The Development of Water Resources for Sydney, by J. L. Bellamy, M.I.E.Aust., K G. Aubrey, M.I.E.Aust. and P. M. MacPherson, B.C.E., M.I.E.Aust.

A Systems Analysis Approach to Determining Australia's Short-Term Urban Road Needs, by H. T. Loxton, M.C.E., B.Sc., M.I.E.Aust. and P. C. Pak-Poy, B.E., M.Eng.Sc., M.I.E.Aust.

Critical Path Evaluations of Construction Work Changes and Delays, by J. M. Antill, M.E., F.I.E.Aust.

Container Terminals—Port of Sydney, by J. M. Wallace, F.I.E.Aust.

The Engineering Potential of Fibre-Reinforced Composite Materials, by L. M. Gillin, B.Met.E., M.Eng.Sc., Ph.D.

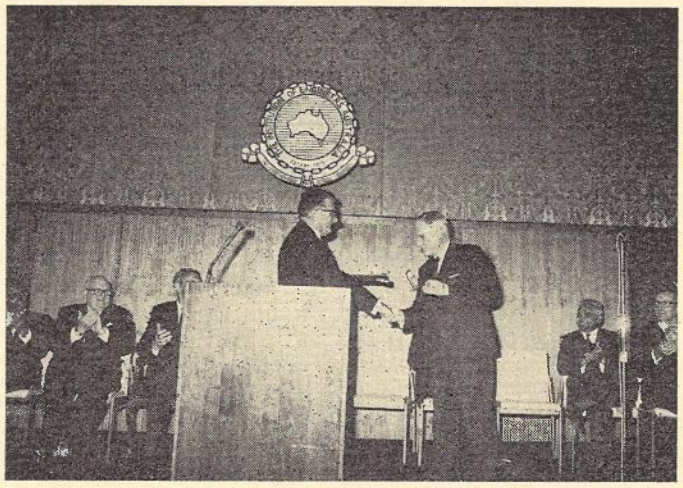
The Use of Fine Ground Granulated Blast Furnace Slag in Concrete, by W. G. J. Ryan, B.E., M.I.E.Aust.

The Case for Vehicle Four-Wheel Drive Hydrostatic Transmission, by R. J. Ifield.

The Development of the Road Vehicle, by W. S. Gaffney, B.Sc. (Eng.).

The Place of Liberal Studies in Engineering Education, by J. F. D. Wood B.Sc., B.E., F.I.E.Aust.

Graphical Representation of Tractor Performance, by W. F. Baillie M.I.E.Aust. and G. H. Vasey, B.C.E., F.I.E.Aust.



The Official Opening—Sir Hubert Shirley-Smith presenting Gavel to the President.

SUNDAY, 13th APRIL.

Church services were held at St. Mary's Cathedral at 10.00 a.m., at St. Andrew's Cathedral at 10.30 a.m. and at St. Stephen's Presbyterian Church at 11.00 a.m. At St. Mary's Cathedral the Mass was celebrated by His Eminence Cardinal Sir Norman Gilroy. At St. Andrew's Cathedral the preacher was The Right Reverend Bishop F. O. Hulme-Moir and the Lessons were read by the President-Elect, Professor J. W. Roderick, and the Vice-President, Mr. F. B. Haigh. At St. Stephen's the preacher was The Reverend Graham W. Hardy and the Lessons were read by the Conference Chairman, Mr. M. B. V. Anderson, and the Conference Organiser, Mr. J. M. Antill.

MONDAY, 14th APRIL.

TOURS.

During the morning those who had registered early had a choice of a number of tours which included the two Universities, places of historical interest, the beaches and a cruise on the harbour.

CIVIC RECEPTION.

At 11.30 a.m. The Honourable H. V. Treatt, Chief Commissioner of the City of Sydney, tendered a Civic Reception to Councillors, Division Chairmen and overseas visitors. He was supported by Mr. J. A. L. Shaw, Deputy Chief Commissioner and a Councillor of The Institution.

OFFICIAL OPENING.

At 2.30 p.m. members and visitors assembled in the Main Ballroom of the Wentworth Hotel for the Official Opening of the Conference by The Honourable L. H. E. Bury, Minister for Labour and National Service, representing the Prime Minister.

While awaiting the official party those present were entertained by the Band of the Royal Australian Engineers.

Mr. M. B. V. Anderson, as Conference Chairman, welcomed visitors and paid tribute to the work of those members and their wives who had given such invaluable service on the Organising Committee and its sub-committees. He referred to the wonderful co-operation that had been received from Government Departments, Universities and private industry in arranging technical inspections.

Mr. Anderson then invited the President of The Institution, Mr. I. Langlands, to take the Chair.

Mr. Langlands said he wished to reinforce Mr. Anderson's welcome to all those who had come to the Conference from overseas and from within Australia. This Jubilee Conference was a momentous occasion in the life of The Institution and it was fortuitous that the Jubilee should have coincided with Sydney Division's turn to be host at The Institution's Annual Conference.

His attention had been drawn to the origin and significance of the word " jubilee ". On reading the Old Testament he had come to wonder whether the right word had been chosen to describe this Conference. A jubilee year was one in which no work was done and during which everything was returned to its original owner. He wished to assure all present that The Institution was not taking a year of rest and it did not intend to return to the Foundation Societies their possessions of 50 years ago.

Mr. Langlands then introduced Mr. Bury and invited him to open the Conference. Mr. Bury said that The Institution was celebrating its 50th anniversary at a time when Australia had reached a new stage in its development. Major discoveries in oil, natural gas, iron ore and other minerals had introduced new and important factors in the national growth. In the international picture were great technological changes which would profoundly affect the lives of everyone.

The professional engineer was at the centre of all these developments. During the past 50 years the Australian workforce had more than doubled. Because of the difficulty of interpreting census statistics the exact increase in the number of professional engineers was not clear. The 1921 census included only two categories specifically for engineers—civil engineers and consulting engineers. The total number of persons claiming to be in these categories was then 1,704. At the 1966 census, 45 years later, nearly 26,000 persons called themselves professional engineers. There was no doubt that this rapid growth in the demand for engineers would continue.

In referring to educational facilities for the training of engineers and ensuring that the young graduate was familiar with the most recent developments in technology, Mr. Bury said the older engineers faced problems in keeping up with scientific and technological advances. He questioned whether there were sufficient opportunities at the right level for experienced engineers to keep themselves up to date. In addition to keeping abreast of technological developments, engineers must keep abreast of management techniques.

The 50th anniversary was a time for looking back but it was also a time for looking forward, and the continued progress of the nation will depend largely on the new people who will take the place of the people who are in the profession today. Mr. Bury then declared the Conference open.

After Professor J. W. Roderick had thanked the Minister for opening the Conference, Mr. Langlands said he had now great pleasure in reading telegrams that had been received from Her Majesty the Queen and from his Royal Highness, Prince Philip, Duke of Edinburgh:

> " Please convey to all members of The Institution of Engineers, Australia the sincere thanks of The Queen for their kind and loyal message which Her Majesty as Patron much appreciates. The Queen sends her warm congratulations to The Institution on the celebration of its Jubilee.
>
> Signed: Private Secretary ".

> " I am most grateful for your message. I know that all engineers in the United Kingdom join me in sending congratulations and best wishes for your Jubilee and Conference. The immense development which has taken place in Australia in only 200 years is largely due to engineers. The future pattern of human life in Australia is also in their hands. I wish all your members every success.
>
> Philip, President of Council of Engineering Institutions."

Greetings and good wishes from their respective Councils were conveyed by Mr. Kulasinghe, Mr. Gupta, Mr. Thean, Mr. North, Mr. Hiew and Sir Hubert Shirley-Smith. Sir Hubert Shirley-Smith apologised for the absence of Sir Leonard Drucquer, Chairman of the Council of Engineering Institutions, who had been on his way to Australia to represent the Council at this Conference when he had become ill in South Africa. His Royal Highness Prince Philip, the President of the Council, had immediately asked who was going to take Sir Leonard's place and he, Sir Hubert, felt privileged that the choice had fallen on him. He had flown straight from London and had arrived only that morning.

On behalf of the Council of Engineering Institutions Sir Hubert presented to The Institution an ivory gavel. On the supporting block are silver plates on one of which are engraved the signatures of the President of the Council and the Presidents of the 14 constituent institutions. Mr. Thean Lip Thong, on behalf of The Institution of Engineers (Malaysia) presented to The Institution a hand-beaten silver salver. On behalf of the New Zealand Institution of Engineers, Mr. North presented four old prints of scenes in Wellington, one of them being the site of the present Headquarters of his Institution.

RECEPTION.

In the evening a Reception and Buffet Dinner was held in the Grand Ballroom. The President and Mrs. Langlands received 715 members and ladies.

TUESDAY, 15th APRIL.

TECHNICAL SESSIONS, TOURS AND INSPECTIONS.

Four technical papers were presented and discussion sessions were held on " The Future of The Institution " and " The Motor Car and the Community ". Tours and inspections included visits to Munmorah Power Station; Australian Iron and Steel Works, Port Kembla; old buildings at Windsor; Palm Beach; British Motor Corporation works, Zetland; P.M.G. Mail Exchange, Redfern; Amalgamated Wireless (A'asia) Pty. Ltd.; Department of Motor Transport, Traffic Control Centre; Maritime Services Board Harbour installations; and the Opera House.

WEDNESDAY, 16th APRIL.

TECHNICAL SESSIONS, TOURS AND INSPECTIONS

One paper was presented and discussion sessions were held on " The Change to Metrics ", " Research and Development in Telecommunications in Australia ", and " The Development of Australia's Water Resources—The Need for Research ".

Some of the tours and inspections of the previous day were again available. In addition, there were visits to Appin and National Park; Warragamba Dam; the Shell Refinery, Clyde; I.C.I.A.N.Z. plant, Mascot; and the Sydney Morning Herald's installations.

JUBILEE BANQUET.

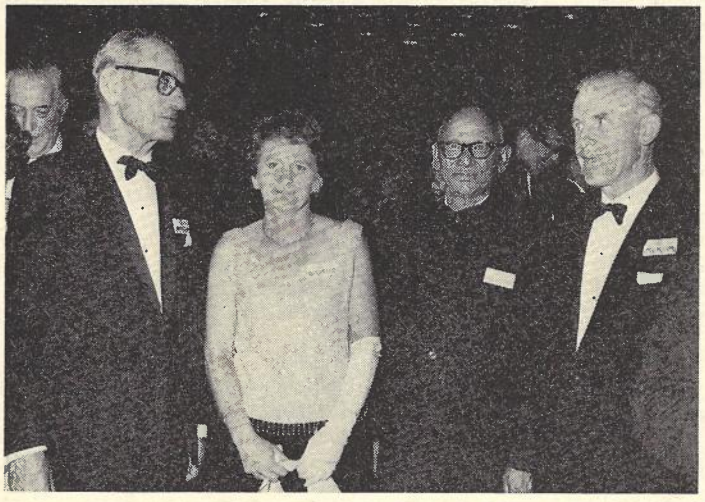
The Jubilee Banquet was held in the Grand Ballroom of the Wentworth Hotel. Seating arrangements limited the attendance to 546 The guests of honour were the Governor-General of Australia, His Excellency The Right Honourable Lord Casey, K.G., G.C.M.G., C.H., D.S.O., M.C., M.A., Hon.F.I.E.Aust., and The Lady Casey. Other distinguished guests included The Honourable J. G. Beale, Minister for Conservation, representing the Premier, and The Honourable H. V. Treatt, Chief Commissioner of the City of Sydney.

The Toast to The Queen was proposed by the President, Mr. I. Langlands. In inviting His Excellency to propose the Toast of The Institution, Mr. Langlands said:

l. to r.—*Mr. Thean Lip Thong, Mrs. Langlands, Mrs. Thean, Mr. I. Langlands.*

l. to r.—*Professor J. W. Roderick, Mrs. Anderson, Mrs. Roderick, Mr. M. B. V. Anderson.*

l. to r.—*Mr. F. B. Haigh, Mrs. Hiew, Mrs. Haigh, Mr. Hiew Siew Nam.*



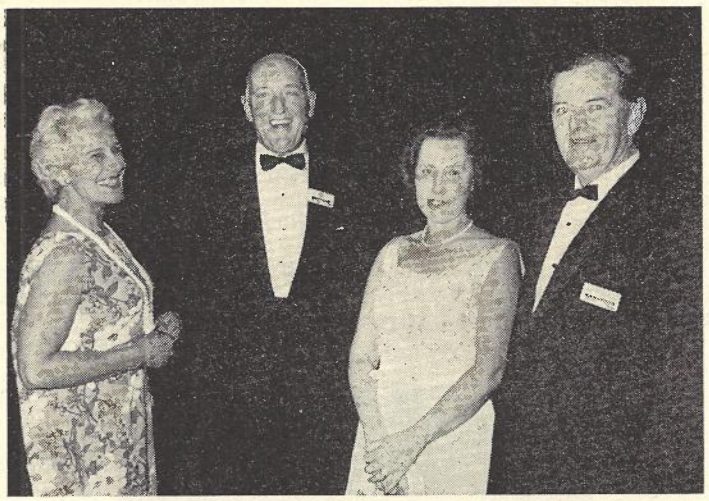
l. to r.—*Mr. C. H. D. Harper, Mrs. North, Shri. T. R. Gupta, Mr. J. C. North.*

l. to r.—*Mr. J. M. Antill, Mrs. Antill, Mr. A. N. S. Kulasinghe.*

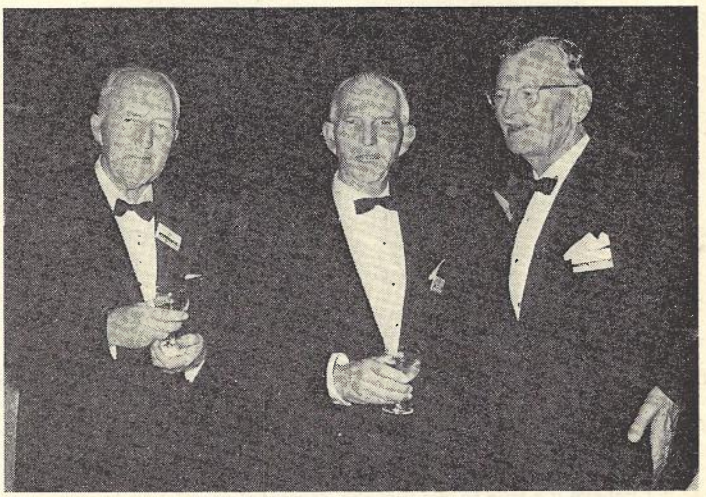
The President's Reception.

l. to r.—*Mr. R. M. Little, Mrs. Little, Mr. W. J. Dunphy, Mrs. Dunphy.*

l. to r.—*Mr. I. J. O'Donnell, Mr. H. T. Loxton, Mr. E. B. Huddleston.*



l. to r.—*Mrs. Sweet, Mr. H. G. Sweet, Mrs. Stevenson, Mr. R. J. D. Stevenson.*



l. to r.—*Mr. J. A. Simpson, Mr. S. M. Munday, Mr. S. C. Robertson.*

The President's Reception.

" Our distinguished guest of honour tonight needs no introduction. He would need no introduction to an audience anywhere in the world. Of few men could this be said, but few men have had such an illustrious career in so many spheres as Lord Casey.

" He graduated in engineering with honours at Cambridge. Shortly afterwards he served in the First World War and the decorations he received are testimony that he did so with distinction.

" Then followed his remarkable career—as a member of parliament and Minister of the Crown, including such important portfolios as Federal Treasurer and Minister for External Affairs—Member of the British War Cabinet and Minister of State in the Middle East—the first Australian Minister to the U.S.A.—Governor of Bengal—and latterly Governor-General of Australia.

" He has found time to publish a number of books and to pursue a wide variety of activities.

" It is not surprising that Her Majesty the Queen should have selected him to be the first Australian to receive the greatest honour in Her Gift—Knight of the Most Noble Order of the Garter.

" We are proud of this great Australian. We are proud that he is a Fellow of this Institution.

" With him tonight is Her Excellency The Lady Casey—a great wife for a great man. Lady Casey is a writer, an artist and an aviatrix—but above all a very charming woman.

" Their Excellencies are a distinguished and accomplished couple. They are also two very simple unaffected friendly people."

When His Excellency rose he was greeted with sustained applause, members recognising that this would be the last occasion on which, as Governor-General, he would be attending a social function. His Excellency said:

" Thank you very much, Mr. Langlands, for your very kindly and generous welcome to my wife and myself, and for what you have been good enough to say.

" My wife and I are delighted to be with you all this evening—and I am most grateful to you for your courtesy in asking me to propose the Toast of The Institution, which I am most glad to do.

" I like to think that I have the beginnings of an engineer in me—although the beginnings are a long while back in point of time. Still I think I have one of the characteristics of an engineer in me, in that the first question I ask when faced with any problem is—" What are the facts ? "—and not until one is reasonably satisfied that one has the main facts of situations can one get down to consideration of what to do about them.

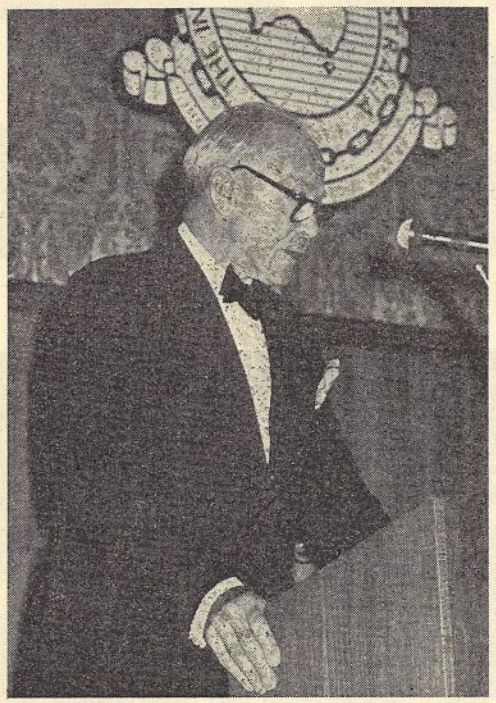
" In building up towards proposing the Toast of The Institution, there are a number of relevant subjects that have occurred to me, but, on reflection, I would believe that most of them are subjects that are likely to be dealt with in the course of your Jubilee Conference, by those much better equipped than I am to speak about them.

" However, there are other subjects that have some relevance to your profession and to your Institution that I would like to say something about.

" The first thought that comes to me is—why your Jubilee—the 50th Anniversary of the founding of your Institution—happens to be in 1969 and not a great deal earlier ? In 1919, about a dozen engineering associations came together to form your present Institution. This was not by reason of the backward state of your profession, which only came into existence in 1919—but because of the very great size of Australia and the provincialisation of your profession amongst six States prior to that date. It was only in 1919 that you were able to ride

over the provincial limitations that inevitably impeded its earlier creation by keeping its component associations apart.

" One is led to considering the framework in which any national professional association comes into being and operates. In our case, I believe it was influenced by the great size of the country, its geographical factors, and the density of its population. In the case of Engineering, all three factors make the creation of a national engineering institution more and not less difficult.



The Jubilee Banquet—Lord Casey proposing the Toast of The Institution.

" As we know, we are, even now, only 12 million people trying to occupy a country of continental size.

"I believe it's true to say that the density of population in any country is a prime factor in determining social and professional attitudes. A country with five or six people per square mile is likely to have characteristics notably different from those of a country with five or six hundred people per square mile. The fact that in certain areas of Australia, the density of population goes up to ten or twelve people per square mile does not notably affect the fact that we are a people with a very low population density, as compared with most other countries.

" Other factors affecting our situation are: the distinct and abnormal segregation of our population in the six capital cities, with relatively little professional or even social association between them, together with the minimal population density in the vast open spaces which are a feature of the rest of the country.

" The great climatic range between north and south, and the relative absence of good natural harbours along our 12,000 miles of coastline, are additional factors which militate against the uniformity of professional practice in the engineering profession.

" However, you have ridden over these disabilities, as compared with more compact countries and populations and I believe we have an engineering profession and an Engineering Institution of which we may well be proud.

" Anyone who looks back on the first 100 years of settlement in Australia will be aware of the phenomenon of " improvisation " that marked this early period, when people, particularly in the Australian outback, had to make-do with rough-and-ready pieces of equipment knocked up by the station blacksmith and carpenter in an effort to achieve something for which they could not turn to some store or engineering workshop. I seem to notice that at least some part of this useful characteristic of improvisation has come down to the present day, when the need for it is fast disappearing. I like to think that even our sophisticated scientific research workers of today have inherited something of this useful characteristic, to their advantage.

" My father, nearly 100 years ago, as a pastoralist in the remote Queensland outback, had a placard in large letters on his desk—" How can I do things better ? "—and had the primitive beginnings of some modern mechanical equipments rigged up for him on his stations.

" I would like to refer to a man whose name deserves recognition even today by his remarkable achievements as an Australian mechanical engineer—A. G. M. Michell, who invented the marine thrust-block in 1905, nearly 70 years ago, and which made possible the large and powerful ships of today, by a device that enabled the high power of ships' engines to be transmitted to the ships' hulls. I mention him in particular, as I knew him quite well in Melbourne in 1920, nearly 50 years ago.

" The propulsion of the modern naval vessels and great passenger ships and bulk carriers, and much else, would not be possible without the Michell thrust-block. Unfortunately for him, Michell had great mechanical genius without appropriate business sense, and as a consequence he made little or nothing out of his inventions.

" Whenever I go over a modern vessel, I ask the Chief Engineer if I might see the Michell thrust-block. He always looks startled and asks how I know about it, as practically nobody else has ever heard the name Michell.

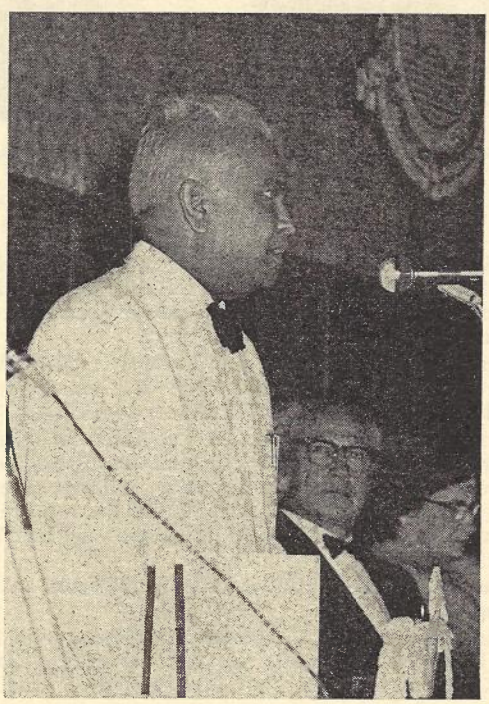
" Well, Mr. Langlands, ladies and gentlemen, I'm afraid I have galloped round a number of subjects, some more relevant than others—and I must not take up any more of your time.

" I end by saying that I regard engineers as the salt of the earth—as people who keep the wheels of industry and of progress turning, each year more effectively and efficiently—and that this Institution is their hub and their backbone.

" I am now glad indeed to have the privilege of asking you all to drink the Toast of The Institution of Engineers, Australia—and may its image and prestige never grow less."

The President-Elect, Professor J. W. Roderick, on behalf of those present and all other members of The Institution, expressed thanks to sent and all other members of The Institution, expressed thanks to His Excellency.

The Conference Chairman, Mr. M. B. V. Anderson, proposed the Toast of the Guests, and Mr. A. N. S. Kulasinghe, President of The Institution of Engineers, Ceylon, responded to the Toast.



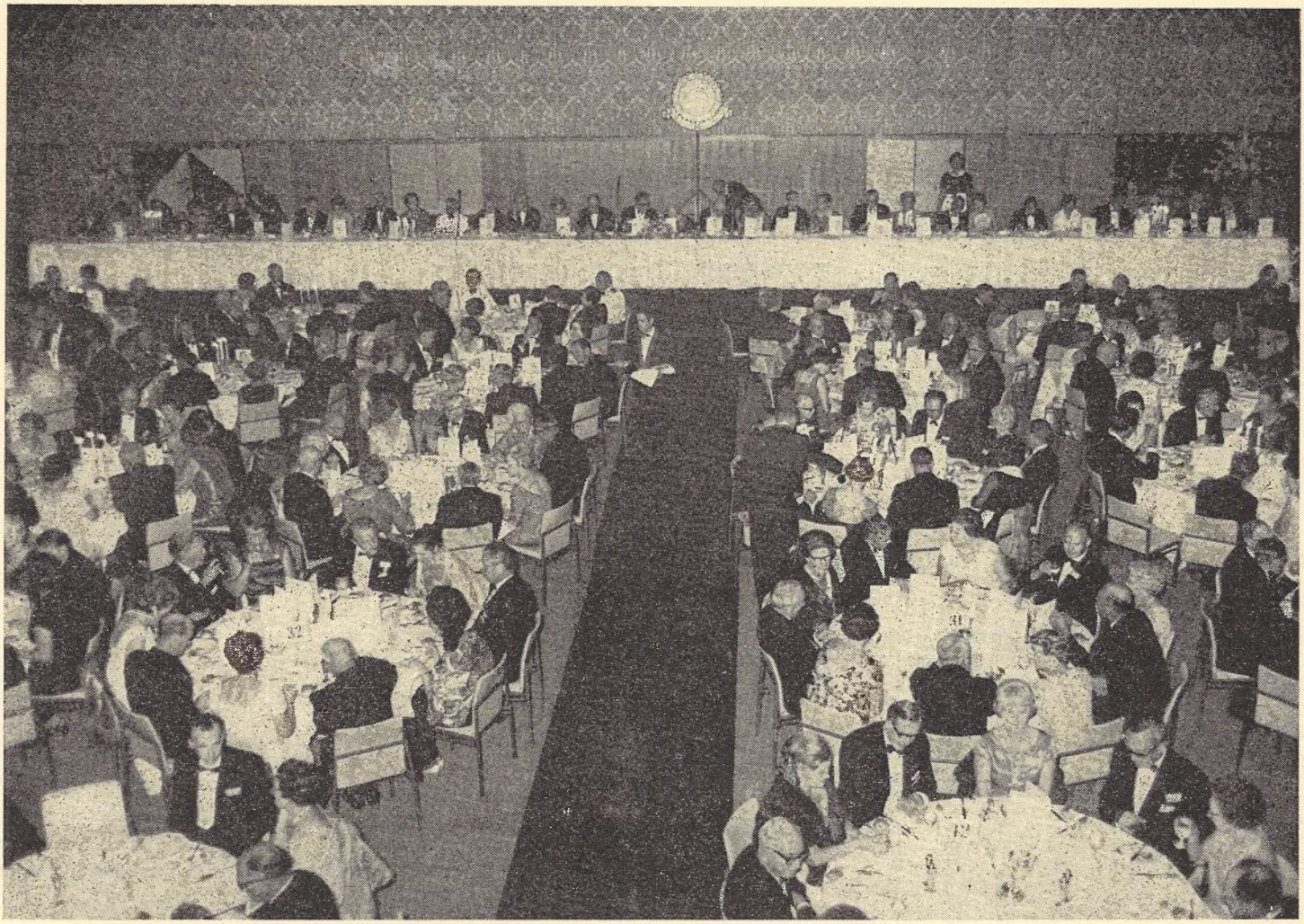
The Jubilee Banquet—Mr. A. N. S. Kulasinghe responding to the Toast of the Guests.

THURSDAY, 17th APRIL.

Technical Sessions, Tours and Inspections.

Five technical papers were presented and there was a discussion session on " The Role of Universities and Colleges in Engineering Education ".

Tours and inspections included the Warragamba Pipeline; Bringelly Road Water Treatment Works and St. Mary's Sewage Treatment Works;



The Jubilee Banquet.

the Captain Cook Dock; the A.C.I. Ltd. glassworks plant; Amalgamated Wireless (A'asia) Pty. Ltd.; the Opera House; British Motor Corporation Works; Channel 10 Television Studios; and Stanton Pipes Division Yennora.

Annual General Meeting.

The Annual General Meeting of The Institution was held in the Grand Ballroom, Wentworth Hotel, at 8.30 p.m. Following the adoption of the Annual Report and Statements of Account, the *Peter Nicol Russell Memorial Medal*, 1968 Award, was presented to Dr. W. H. Connolly, C.B.E., B.E.E., D.Eng., B.Com., F.I.E.Aust. Other Institution prizes and awards were presented.

The President of The Institution, Mr. I. Langlands, delivered his Presidential Address which is published in this issue of The Journal. Mr. Langlands then installed Professor J. W. Roderick, M.Sc., Ph.D., M.A.(Cantab.), F.I.E.Aust., as President of The Institution for the ensuing year.

FRIDAY, 18th APRIL.

Technical Sessions, Tours and Inspections.

Three technical papers were presented. Tours and inspections included visits to the Australian Atomic Energy Commission Research Establishment; the University of New South Wales; the University of Sydney; The Bondi Sewage Treatment Works; King's Cross Tunnel; Palm Beach; and the Cellars of Penfolds Wines Pty. Ltd.

Farewell Luncheon.

Some 389 members and guests and their wives came together in the Grand Ballroom of the Wentworth Hotel for a buffet luncheon and to bid each other God speed on their return to their homes.

Professor Roderick, as President, thanked the Conference Committee and the Ladies Committee for the excellent arrangements that had been made for the Conference and which had ensured its success. He said that he was reluctant to mention names when so many had done so much, but he felt that he must pay a special tribute to Mr. M. B. V. Anderson, as Conference Chairman, Mr. J. M. Antill, as Conference Organiser, and Mrs. Anderson as Chairman of the Ladies Committee.

Mrs. Langlands, on behalf of visiting ladies, thanked the local Committee for the warmth of their hospitality.

Pre-Sessional and Post-Sessional Tours.

The pre-sessional and post-sessional tours covered a wider area than is usual for a Conference in a capital city. They included Broken Hill, the Snowy Mountains area, the Central West of New South Wales, Newcastle and District, Canberra and surrounding areas, and the Riverina.

Conclusion.

The Council of The Institution extends its very sincere thanks to all the members of the Conference Committee, the Ladies Committee, and the many sub-committees for organising such a successful Conference on the occasion of The Institution's Jubilee.

THE INSTITUTION OF ENGINEERS, AUSTRALIA

1970 CONFERENCE

MELBOURNE, 16th-20th MARCH

Theme—

" ENGINEERING IN THE SEVENTIES "

Tentative Programme

Abbreviations:— CCC—Camberwell Civic Centre
NG —National Gallery

Chartered buses will run from the City to CCC and return.

Dates	*Times*	*Details*
Wed. (11th)-Sat. (14th)		Pre-Conf. Tour—Mt. Macedon, Eppalock, Bendigo, Shepparton, Goulburn Valley, Winery.
Saturday (14th)	9.00	Council Meeting: Hotel Windsor.
Sunday (15th)	11.00-12.05	Church Services, St. Paul's and St. Patrick's Cathedrals.
	12.15- 1.30	Luncheon—Southern Cross Hotel.
	1.30- 6.00	Visit to Mt. Eliza Admin. Staff College—Men Visit to Mornington Peninsula and Arthur's Seat—Ladies and Children.
Monday (16th)	9.00-12.30	City Sights; NG; Inspections. Registration (non-Melbourne delegates).
	3.00- 4.00	Official Opening } Melbourne Town Hall
	4.15- 5.00	Afternoon Tea } Melbourne Town Hall
	7.30-10.30	President's Reception—Buffet—New National Gallery—Great Hall.
Tuesday (17th)	9.00- 5.00	Day Tour—Dandenong Industries.
	9.00-12.30	Morning Tours and NG.
CCC	9.15-12.15	Papers—CONCEPTS: National Planning—The Executive, The State and The Engineer—Reality and Ideal. The Engineer and The National System. Industry and Community Requirements of Engineering.
	12.30- 1.45	Lunch
	2.00- 5.00	Afternoon Tours and NG.
CCC	2.15- 5.15	Papers—CONCEPTS: Engineering Developments—Their Impact on Industry, The Community and The Profession. Development of Professional Engineering Resources for the Seventies. Engineering Sub-Professional Work.
	7.30-12.00	Dinner Dance—Hunters Lodge, Croydon (Informal).
CCC	8.00-10.30	Family Film Night—Documentary and Scientific.
Wednesday (18th)	8.30- 5.00	Day Tour—Ballarat.
	9.00-12.30	Morning Tours and NG.
CCC	9.15-12.15	Papers—TECHNIQUES—Transport (3) and Energy (3).
	12.30- 1.45	Lunch.
	2.00- 5.00	Afternoon Tours: NG: Technical Inspections.
CCC	2.15- 5.15	Papers: TECHNIQUES—Technology (3) and Management (3). G & S—" What Every Young Engineer Should Know ".
CCC	7.30-10.30	Conference Banquet.
Thursday (19th)	9.00- 5.00	Day Tour—The Blue Dandenongs—Beauty Spots and Industries.
	9.00-12.30	Morning Tours: NG: Technical Inspections.
CCC	9.15-12.15	Papers—TECHNIQUES—Transport (3) and Technology (3).
	12.30- 1.45	Lunch.
	2.00- 5.00	Afternoon Tours: NG: Technical Inspections.
CCC	2.15- 5.15	Papers—TECHNIQUES—Energy (3) Management (3).
	8.00-10.30	Annual General Meeting. Also Programme for ladies not attending A.G.M. } Supper.
Friday (20th)	8.45- 5.00	Day Tour—Geelong.
	9.00-12.30	Morning Tours.
CCC	9.15-12.15	Papers—Review Session and " The Future of The Institution ".
	12.30- 2.00	Farewell Luncheon.
CCC	8.00- 2.00	Dance for All Ages organised by G. & S. Section (Informal).
Saturday (21st)	8.00- 6.00	Day Tour—Latrobe Valley Industrial Undertakings.
Sat. (21st)-Sun. (22nd)		Post Conference Tour—Latrobe Valley, South Gippsland, Esso-B.H.P. plant.

For accommodation information write to Mr. N. E. White, T.A.A., 50 Franklin St., Melbourne, 3000.

The Conference Committee has announced that Bulletin No. 1 will be issued as a supplement to the October-November issue of THE JOURNAL.

AUSTRALIAN CONFERENCES

Symposium on Heat Exchange

Brisbane, October, 1969

This Symposium will cover the design and application of exchangers in a variety of industries and is intended to be of interest and assistance to practising engineers who have some fundamental knowledge of and some special interest in this subject.

Lecture and discussion sessions will be held in The Institution Building, 447 Upper Edward Street, Brisbane, on Monday evenings 6th, 13th, 20th and 27th October, 1969, commencing each evening at 6 p.m.

Lecture notes and a light buffet tea will be provided each evening.

The lecture programme (subject to probable minor alterations) is as follows:—

6th October—"Mechanical Design of Heat Exchangers"—P. A. Juler, University of Queensland.

"Basic Principles of Heat Transfer"—P. C. Brooks, University of Queensland.

13th October—"Manufacture of Refrigerant to Liquid Heat Exchangers for the Air Conditioning and Refrigeration Industry"—Carrier Air Conditioning Pty. Ltd.

"Manufacture of Air to Water or Refrigerant Heat Exchangers for the Air Conditioning and Refrigeration Industry"—C. J. Sarelius, Chief Engineer, F. Muller Pty. Ltd., Sydney.

"The Selection and Application of Heat Exchangers in the Air Conditioning Industry"—A Consulting Engineer.

20th October—"Manufacture of Industrial Heat Exchangers"—J. Crocker, Chief Engineer, Bernard Smith & Co., Sydney.

"Heat Exchanger Maintenance"—D. Armstrong, Engineering and Maintenance Manager, Amoco Refinery, Brisbane.

"Problems of Special Heat Exchangers"—B. Hiskens, Plant Engineering Manager—Queensland Alumina, Gladstone.

27th October—"Heat Exchange in the Power Generating Industry"—I. Dennis, Deputy Chief Engineer, Planning, Southern Electric Authority, Queensland.

"Computer Determination of Fouling Factors"—J. McInerney, Ampol Refinery, Brisbane.

"Heat Exchangers in the Food Industry"—Bell-Bryant Pty. Ltd.

The Symposium has been arranged by the Mechanical Engineering Branch of the Queensland Division. All enquiries should be addressed to The Secretary, The Institution of Engineers, Australia, Queensland Division, 447 Upper Edward Street, Brisbane, 4000.

Earthquake Engineering Symposium

Melbourne, October, 1969

The Structural Branch of the Victoria Division, in association with The Australian Institute of Physics, will conduct a Symposium on earthquake engineering in Melbourne on Thursday, 16th October, Friday, 17th October, and the morning of Saturday, 18th October, 1969.

The objectives of the Symposium are to

(*a*) bring together engineers and seismologists interested or involved in the design of structures for New Guinea, New Zealand and other seismically active areas;

(*b*) provide a forum for engineers and seismologists interested in discussing and formulating an objective appraisal of Australian seismicity in relation to structural design;

(*c*) form a National Committee on Earthquake Engineering which would hold membership in the International Association for Earthquake Engineering.

Speakers will be expert seismologists and structural engineers from Australia, U.S.A., and New Zealand.

Enquiries may be made to The Secretary, The Institution of Engineers, Australia, Victoria Division, 191 Royal Parade, Parkville, Vic. 3052.

The Symposium Bulletin was published as a supplement to the July-August issue of THE JOURNAL.

Hydrology Symposium

Hobart, February, 1970

A Symposium organised by The Institution's Technical Committee on Hydrology will be held in Hobart on 18th and 19th February, 1970.

It is anticipated that there will be a conducted tour of the Gordon River area on Saturday, 20th February.

Symposium on Soils and Earth Structures in Arid Climates

Adelaide, May, 1970

A two-day Symposium on Soils and Earth Structures in Arid Climates, organised by the Australian National Society of Soil Mechanics and Foundation Engineering, will be held in Adelaide on 21st and 22nd May, 1970.

Data Transmission Conference

Brisbane, June, 1970

A three-day Conference on Data Transmission, organised by the Electrical and Electronics Board of The Institution, will be held at the University of Queensland on 3rd, 4th and 5th June, 1970.

The Conference will cover Data Transmission in all its aspects including transmission media, modulation techniques, coding, error detection, public and private switched networks, computer interface.

A prospective author should forward a summary of his proposed paper to the Conference Organising Committee Convener,

c/o The Institution of Engineers, Australia,
447 Upper Edward Street,
BRISBANE 4000,

by 15th October, 1969. A summary of approximately 500 words should be sufficient to allow assessment by the Conference Committee of the proposed paper in regard to content, approach, significance and relevance to the theme of the Conference.

Papers will be selected on the basis of their suitability for presentation at the Conference and will be reproduced as preprints from authors' manuscripts by an offset process. Subsequently any author may submit his paper, with modifications if necessary, for publication in the Electrical Engineering Transactions of The Institution.

Authors selected will be advised by 30th November, 1969, on the procedures to be followed in preparing the manuscript, which is to be in the hands of the Conference Committee by 27th February, 1970.

Thermodynamics—Industrial Applications

Conference—Adelaide—August, 1970

The Institution's Technical Committee on Applied Thermodynamics is organising a Conference to be held in Adelaide in August, 1970.

Papers dealing with all branches of Thermodynamics, in particular those oriented to an industrial application, are invited from prospective authors.

Papers will be reproduced from author's manuscripts by offset process and must therefore be typed in accordance with instructions. A Synopsis of 200-300 words must be submitted by 13th February, 1970.

Complete manuscripts must be in the hands of The Secretary by 28th April, 1970.

Papers will be selected for preprinting and presentation on the basis of their suitability for the Conference. They will be preprinted as separates in limited numbers. After the Conference, discussion will be printed and made available to participants. Since there will be no formal proceedings, the papers and discussion will not be published in any of The Institution's regular publications, but any author may submit his paper, with modifications if necessary, for publication in the *Mechanical & Chemical Engineering Transactions*.

Prospective authors may obtain the instructions for the format of papers from The Secretary, The Institution of Engineers, Australia, Science House, 157 Gloucester Street, Sydney, N.S.W. 2000.

1971 Annual Engineering Conference

The 1971 Annual Conference of The Institution will be held in Adelaide from 21st to 27th March, 1971.

The organising committee is seeking papers appropriate to the Conference at which members representing all branches of the profession will be present. Preference will be given to papers of the following types:—

1. Papers in which the history and the current state of engineering practice in a particular broad field is reviewed in a manner of value and interest to members of all branches.

2. Papers describing the overall technical, managerial and social aspects of major engineering works.
3. Papers concerned with management, particularly its financial aspects, dealt with from an engineer's point of view.
4. Papers dealing with developments in engineering education, particularly the place of systems engineering studies in engineering courses.

Papers which are accepted will be preprinted in a volume of Conference papers for circulation to those who register for the Conference, in time to enable them to study the papers and prepare discussion. Following the Conference, they will be printed in THE JOURNAL or one of the *Transactions*, with discussion.

Papers to be considered for the 1971 Conference must be submitted in triplicate to the Secretary of The Institution by 14th August, 1970. It will not be possible to accept Conference papers after that date. Papers are not to exceed 6,000 words.

It will assist the Conference Committee if prospective authors will advise, as soon as possible, of their intention to submit a paper and provide a title (provisional) and a summary of about 200 words.

It is recommended to authors that before they commence preparation of a paper, they obtain from the Secretary of The Institution or their Division Office a copy of The Institution's publication *The Preparation and Submission of Technical Papers*.

Sixth Australia-New Zealand Conference on Geomechanics

Melbourne, August, 1971

The Sixth Australia-New Zealand Conference on Geomechanics (incorporating soil and rock mechanics) will be held in Melbourne from 10th to 17th August, 1971.

The main theme of the Conference will be " Structure and its Effect on Soil and Rock Properties ". Prof. T. William Lambe, of the Massachussetts Institute of Technology, has accepted an invitation to attend the Conference and to deliver the keynote address. Authors are also invited to submit papers on topics in soil and rock mechanics other than the main theme.

Papers for consideration must be submitted by 30th November, 1970, but it would assist the Organising Committee if authors would advise (as early as possible) their intention, with a brief indication of the subject matter. Papers which are accepted will be preprinted for circulation in advance to those who will be attending the Conference.

Further information may be obtained from the Secretary, The Institution of Engineers, Australia, Science House, 157 Gloucester Street, Sydney, N.S.W. 2000.

A.R.R.B. Symposium on Compaction

Wagga Wagga, October, 1969

A two-day Symposium on compaction of materials in roads is to be held in the City of Wagga Wagga, N.S.W., on 10th and 11th October, 1969.

Further information may be obtained from The Compaction Symposium Secretary, Australian Road Research Board, 60 Denmark Street, Kew, Victoria 3101.

Symposium on Coupled Heat and Mass Transfer Processes

Melbourne, 1st December, 1969

This Symposium will be held at C.S.I.R.O. Division of Mechanical Engineering, Highett, Victoria, on Monday, 1st December, 1969, from 10 a.m. to 5 p.m. Its purpose is to establish closer contact between those interested in this field. This Symposium follows a similar meeting at the Division on 16th October, 1964.

The main theme of the Symposium is coupled heat and mass transfer between a sorbent porous medium and an interstitial fluid mixture. The theme arises from the Division's work on grain aeration systems, regenerative heat exchangers and dehumidification with solid desiccants, and interest in drying and regenerative heat and moisture exchangers. Other related work will be considered for inclusion.

It is planned to have sessions at which participants' work will be described, and sessions at which questions found to be of common interest will be discussed.

Those wishing to participate are asked to submit a brief statement of their interest in the field of work described above. This statement may take the form of a summary of papers recently published, a description of a current research project, or a description of a practical system or industrial process of interest to the participant and in which coupled transfer processes occur. Statements should not exceed two foolscap pages in length, and should be submitted before 30th October. A list of participants, with an indication of their interest in the field, will be circulated early in November.

All communications relating to the Symposium should be addressed to Dr. P. J. Banks, C.S.I.R.O. Division of Mechanical Engineering, P.O. Box 26, Highett, Victoria 3190.

1970 International Solar Energy Society Conference

Melbourne, March, 1970

The above Conference will be held in Melbourne from 2nd to 6th March, 1970.

The programme will include preprinted papers, and tours to solar installations, also social functions for delegates and wives.

The Conference Chairman is Mr. R. N. Morse and the Organiser is Mr. F. G. Hogg, C.S.I.R.O., P.O. Box 26, Highett, Victoria 3190.

Fourth Australian Building Research Congress

Sydney, August, 1970

The Commonwealth Experimental Building Station will be the host organisation at the Fourth Australian Building Research Congress, to be held at the University of Sydney on 11th, 12th and 13th August, 1970.

The theme of the Congress will be " The Multi-Storey Complex ". Further details may be obtained from The Director, C.E.B.S., P.O. Box 30, Chatswood, N.S.W. 2067.

Safe Load Tables for Structural Steel

The Australian Institute of Steel Construction has compiled and published a 272-page book containing tables and notes, covering the relevant properties of the full range of Australian structural steel shapes and sections (simple and compounded).

All the tables published have been calculated by computer, and are based on the S.A.A. Steel Structures Code AS CA1—1968. Separate, coloured index sections are provided for both normal and high strength steels.

The book is available from the Institute at 84 Pacific Highway, North Sydney, N.S.W. 2060. The price is $3.84 (postage paid).

When you Change your Address

When you change your address please advise your Division Secretary in writing, giving your name in full, your former address and the new address.

Every year more than 3,500 members of The Institution change their address, and although in the majority of cases The Institution's records are adjusted fairly promptly and the members concerned receive publications and other material at the new address, mistakes do occur and these are very irritating to the members concerned. The staff of The Institution, both at Headquarters and Divisions, do not wish to offer excuses for those mistakes which are their fault, but generally the mistakes occur because members do not supply the full information or telephone instead of writing.

It should be appreciated that we now have many members who not only have the same surname, but the same initials and in some cases, the same christian names. It is for this reason that we ask members to let us have not only their full names but the old address. On many occasions we have altered the records of the wrong member and in some cases have transferred him to another Division.

When a change of address is telephoned, it may be that other members of the staff are at lunch and a new junior takes the message. It is very easy to misunderstand a name and initials over the telephone, and when the responsible officer is confronted with a name of which The Institution has no record, he realises that in due course an annoyed member is going to continue to receive mail at his old address.

Some members in moving to another State have telephoned the Division office in that state, notifying change of address but without indicating from where they have moved. In this case the new Division would have no record of the person concerned and again it is easy for junior staff to assume that the change of address will come forward from the member's former Division. The change of address should therefore be notified to a member's old Division or to the Headquarters of The Institution but not to the new Division into which he has moved.

The staff are always reluctant to accept a telephone notification without checking. Practical jokers have been known to advise of the change of address of a member to his and The Institution's embarrassment.

In writing, if the letter is not typed, it is essential that the address and the member's name be printed and that the State be shown. There are many towns in Australia which have the same name as towns in other States. There is at present in the headquarters a notice of a change of address on which, regrettably, no action can be taken. The letter is handwritten, and the address and the signature are completely illegible. In due course, no doubt, this member's name will be published in a list of addresses wanted when mail starts to come back from the deadletter office.

May we repeat, please advise changes of address by letter, giving full name, former address and present address.

Senior Vice-President, 1970

At the Meeting of the Council on 31st July, 1969, Mr. B. J. Callinan, D.S.O., M.C., B.C.E., F.I.E.Aust., was elected Senior Vice-President of The Institution for the year 1970. Mr. Callinan will assume office as President of The Institution in 1971.

Honorary Fellow of The Institution

Sir Ronald East, C.B.E., M.C.E., Hon.F.I.E.Aust.

The President of The Institution announced on 31st July, 1969, that Sir Ronald East had been elected an Honorary Fellow of The Institution.

The Bye-laws provide that an Honorary Fellow shall have rendered conspicuous service to the profession of Engineering. The number of Honorary Fellows may not at any time exceed twenty.

Sir Ronald East was born in Melbourne in 1899. He was educated at Scotch College and the University of Melbourne, interrupting his course after the first year to serve overseas with the Australian Flying Corps. Returning from active service in 1920, he graduated Bachelor of Civil Engineering in 1922 and Master of Civil Engineering in 1924.

He joined the staff of State Rivers and Water Supply Commission of Victoria on graduating and in 1935 was appointed a commissioner. The following year he became Chairman of the Commission and Commissioner representing Victoria on the River Murray Commission, which positions he held until his retirement in 1965. He led the Commission at a period of spectacular developments in water conservation and utilisation in which over $240,000,000 was spent on new works.

He was associated with the Snowy Mountains Project from its inception, was a Member of the Interim Advisory Council from 1953 to 1958 and a Member of the Snowy Mountains Council from 1959 to 1965. He was an official Australian delegate at many overseas conferences.

His professional eminence was recognized by the award to him of the Kernot Memorial Medal in 1949, the Peter Nicol Russell Memorial Medal in 1957, and the Sir James Barrett Award in 1960.

Sir Ronald played a major role in the initiation of important legislation on the control of natural resources, and was the author of many authoritative published papers.

Throughout his career he took a most active part in the affairs of The Institution of Engineers, Australia, of which he was a Councillor for many years and President in 1952-53.

For his outstanding services to his State and the Commonwealth he was appointed a C.B.E. in 1951, and a Knight Bachelor in 1966.

Essay Competition on Welding

Prize $100

The Australian Welding Research Association has provided a prize of $100 to be awarded for the winning essay submitted to the Association in accordance with the conditions laid down. Further information can be obtained from The Director, A.W.R.A., 307 Pitt Street, Sydney, 2000, to whom essay entries must be submitted not later than 30th April, 1970.

The competition is open to students attending Universities or Technical Colleges who are studying for a degree or diploma or carrying out post-graduate study for higher degrees or diplomas, who are aged not more than 25 years at the date of Competition closure, which is 30th April, and who have attended schools within the previous six months.

The essay shall consist of a description of, or treatise on, welding or fabrication, processes which include welding or welding problems or associated fundamental problems. The subject-matter should preferably bear a relationship to the student's own work. Elementary descriptions of common practices of welding are not acceptable.

Earthquake Engineering Authority to give Public Addresses

Mr. Elliott O. Stephenson, Chief Structural Engineer for the American Iron and Steel Institute, who will give the Keynote Address at the Earthquake Engineering Symposium to be held in Melbourne from 16th to 18th October, 1969, will also give public talks in Adelaide, Perth, Sydney, Brisbane and Canberra—on 20th, 21st, 22nd, 23rd and 24th October, respectively.

Information regarding the Symposium was included in a supplement to the July-Aug. issue of THE JOURNAL, and details regarding Mr. Stephenson's public talks may be obtained from the Australian Institute of Steel Construction, 84 Pacific Highway, North Sydney, N.S.W., 2060.

RESEARCH AND DEVELOPMENT COMMUNICATIONS

JACKET SIDE NUSSELT NUMBER

For large jacketed vessels, there seems to be little guidance for the prediction of the jacket-side heat transfer coefficients under turbulent forced convection conditions.

Nusselt numbers were derived from experiments using water with radial or tangential injection into vertical cylindrical jackets. The Nusselt numbers were compared with the Prandtl analogy relation. The use of a semi-theoretical characteristic velocity in evaluation of the Reynolds group, coupled with previously published friction factor values, resulted in reasonable agreement. For the case of tangential injection, stimulus-response data were used to postulate a simple flow model.

The work has been reported in detail and submitted for publication.

I. H. LEHRER.

Dept. of Chemical Engineering,
Monash University,
Clayton, Victoria 3168.

Correction

It is sincerely regretted that in the March, 1969, issue of THE JOURNAL the name of Warwick Harvey HOLMES was included under the heading "Deaths". This resulted from what appeared to be an official notification to The Institution.

We are pleased to record that Mr. Holmes is still a member of The Institution and express to him regrets for any embarrassment he has been caused.

The University of New South Wales

Fellowships in Highway Engineering

Applications are again invited this year for:

(*a*) The Mobil Fellowship in Highway Engineering endowed by Mobil Oil Australia Pty. Ltd.

(*b*) Postgraduate Fellowships endowed by the University.

(*c*) In addition, a further fellowship has now been endowed by Messrs. Blue Metal Industries Ltd.

The Mobil Fellowship and the University Fellowships are valued at $2,350 with free tuition fees. The Blue Metal Industries Fellowship is valued at $2,500 out of which the awardee will have to pay University fees. The awards will be made to enable anyone holding a Bachelor's degree in Civil Engineering to take the one-year course leading to the degree of Master of Engineering Science. Alternatively, in the case of the Blue Metal Industries Fellowship the award may be given for the full-time Diploma course in Highway Engineering or for research for a higher degree in the School of Highway Engineering on a subject concerning highway or bridge materials or consideration may be given to an appropriate stipend for a part-time student.

The course is divided into six main subjects: Road Location and Design, Pavement Design and Soil Analysis, Road Construction, Bridge Design, Traffic Engineering, Highway Law and Contract Documents.

The next course will commence on Monday, 2nd March, and will continue until the end of the following November.

Further particulars of the course, application forms for the fellowships and a prospectus of the School, can be obtained from the Registrar or the Professor of Highway Engineering, University of New South Wales, P.O. Box 1, Kensington, N.S.W. 2033. Completed applications should be returned as soon as possible.

Erratum

AN APPROXIMATION METHOD FOR FOURIER TRANSFORM INVERSION APPLIED TO DISTRIBUTED PARAMETER SYSTEMS

BY C. P. JEFFRESON, B.E., M.TECH., M.I.E.AUST.

It is regretted that Figs. 1, 2 and 3 were inadvertently omitted from the Discussion of this paper, as published in the March, 1969, issue of the *Electrical Engineering Transactions* (p. 84). These figures (which should have been numbered D1, D2 and D3) refer only to the Discussion. The complete Discussion with the figures will be published in the September, 1969, issue of the *Electrical Engineering Transactions*.

The Library and Library Services

All books and periodicals may be borrowed by members. The initial loan period is two weeks but an extension will be granted if other members are not waiting for the publication.

The Library Book List, 1966, is available on request, at 40c, post free.

Material not in the Library can be obtained through The Institution's reciprocal borrowing arrangements with other libraries.

Lists of references will be prepared for members.

Photocopies will be supplied at cost—approximately 20c per page for unbound periodicals, and 45c per page for bound volumes.

Enquiries and requests—

Telephone: The Librarian, 27-8264, 27-5844.
Telegrams: Librarian, care Enjoaust, Sydney.
Letters: The Librarian,
The Institution of Engineers, Australia,
Science House,
157 Gloucester Street,
SYDNEY.

Recent Additions to the Library

(All publications listed are available for loan.)

Serial Publications

AUSTRALIA. *Department of Supply. Weapons Research Establishment, Salisbury, South Australia.*
Technical Note:
No. HSA 139, December 1968—A method for removing numerical instability from the solution of the inverse thick-shell heating problem, by I. C. Heron.

DIESEL ENGINEERS AND USERS ASSOCIATION. *London.*
Publication:
No. 325, May, 1969—Gas turbines and the total energy concept, by K. A. Bray and J. R. Tyler.

GREAT BRITAIN. *Ministry of Public Building and Works. Building Research Station.*
Digest (First Series)
No. 47, revised August, 1963, reprinted 1968—The control of lichens, moulds and similar growths on building materials.
Digests (Second Series)
No. 6, January, 1961, reprinted December 1967—Drainage for housing.
No. 21, revised 1968—New types of paint.
No. 27, revised 1968—Rising damp in walls.
No. 35, revised 1968—Shrinkage of natural aggregates in concrete.
No. 44, 1966—Safety in domestic buildings—2.
No. 51, revised, 1968—Developments in roofing.
No. 57, revised 1968—Painting walls: 3.
No. 60, revised 1968—Chimney design for domestic boilers.
No. 73, revised 1968—Prevention of decay in window joinery.
No. 104, April, 1969—Floor screeds.
No. 106, June, 1969—Painting woodwork.

GREAT BRITAIN. *Ministry of Transport. Road Research Laboratory.*
RRL Reports:
No. LR 219, 1968—Design of a dynamic weighbridge for recording vehicle wheel loads, by J. J. Trott and J. W. Grainger.
No. LR 231, 1968—Failure of plain concrete under fatigue loading—a review of current knowledge, by K. D. Raithby and A. C. Whiffin.

INDIA. *Central Board of Irrigation and Power. New Delhi.*
Publications:
No. 84, August, 1967—Symposium on efficiency of water distribution and use on the land.
No. 85, August, 1967—Symposium on economics and financing of irrigation, drainage and flood control works.

INSTITUTION OF ENGINEERS, AUSTRALIA. *Queensland Division.*
Technical Papers (Pre-print):
Vol. 10, No. 7, July, 1969—Hydrology without tears and other stories, by G. Cossins.
Vol. 10, No. 8, July, 1969—Laser applications in engineering, by N. H. Walden.
Vol. 10, No. 9, July, 1969—The construction of Stage I of the chemical fertilizer complex at Gibson Island, by H. G. Barter.

LONDON. *University. Queen Mary College.*
Annual Report. Session 1967-68.

NEW SOUTH WALES. *University. Wollongong University College.*
Bulletin:
No. 21, April, 1969—Solution of land sub-division layouts by digital computer, by M. J. Lowrey.

QUEENSLAND. *University. Department of Civil Engineering.*
Bulletin:
No. 11, May, 1969—Analysis by computer: axisymmetric solution of elasto-plastic problems by finite element methods, by J. L. Meek and G. Carey.

SYDNEY. *University. School of Civil Engineering.*
Research Reports:
No. R 104, September, 1968—A theoretical study of the interaction of structure and foundation, by I. K. Lee and H. B. Harrison.
No. R 115, March, 1969—Analysis of end-bearing and floating pile groups, by H. G. Poulos and N. S. Mattes.
No. R 116, March, 1969—Development and instrumentation of the model road test track at Sydney University, by G. H. Sparks, H. Taylor and I. K. Lee.
No. R 118, June, 1969—Displacements in a soil mass due to piles and pile groups, by H. G. Poulos and N. S. Mattes.
No. R 120, June, 1969—One-dimensional consolidation of layered soil deposits, by E. H. Davis and I. K. Lee.

SWISS FEDERAL INSTITUTE OF TECHNOLOGY. *Zurich.*
Dissertation:
No. 4118, 1968—Study of a novel PCM repeater and certain considerations pertaining to PCM repeaters based on the frequency entrainment principle, by Pitro Zafiropulo.

UNITED STATES. *Army. Corps of Engineers. Waterways Experiment Station. Vicksburg.*
Contract Report:
No. H-68-2, August, 1968—Motions of small boats moored in standing waves, by F. Raichlen.
Miscellaneous Paper:
No. C-69-6, June, 1969—Concrete cores from Dry Dock No. 2, Charleston Naval Shipyard, S.C., by Alan D. Buck and Katherine Mather.
Technical Reports:
No. C-69-6, May, 1969—Effects of duration of moist curing on concrete made with blended cements or pozzolans. Report I—Laboratory investigations of ¾ in. aggregate concrete, by W. O. Tynes.
No. H-69-6, April, 1969—Design for expansion of Port San Luis, California—Hydraulic model investigation, by C. E. Chatham and C. W. Brasfield.
No. H-69-7, 1969—Spillway for Rend Lake Reservoir, Big Muddy River, Illinois—Hydraulic model investigation, by B. P. Fletcher and J. L. Grace.

UNITED STATES. *National Bureau of Standards.*
Handbook:
No. 105-1, April, 1969—Specifications and tolerances for reference standards and field standard weights and measures. I. Specifications and tolerances for field standard weights, by Thomas M. Stabler.
National Standard Reference Data Series:
No. NSRDS-NBS 26, June, 1969—Ionization potentials, appearance potentials, and heats of formation of gaseous positive ions, by J. L. Franklin and others.
Special Publications:
No. 303, May, 1969—Mechanical and thermal properties of ceramics, edited by J. B. Wachtman. (Proceedings of a symposium held at Gaithersburg, Maryland, April 1-2, 1968).
No. 313, May, 1969—Making valuable measurements—Proceedings of the 1968 Standards Laboratory Conference, edited by H. L. Mason.

New Books

The books listed below have recently been received from the publishers and are all available for loan from the Library. The following information is from that supplied by the respective publishers.

BLAINEY, Geoffrey. *The rush that never ended; a history of Australian mining.* 2nd ed. Melbourne, Melbourne University Press, 1969. 389p. $2.85 (Aust.).

622.1

This book, first published in 1963, was reprinted in 1964 with minor corrections, but the boom in Australian mining called for this larger revision which adds ten thousand words to that material already included on the new mining fields. It is an up-to-date, compelling and well-documented history covering natural gas, nickel, phosphates, bauxite, gold, silver, lead and copper, and narratives about pioneers, prospectors, gamblers and industrial giants.

CLARKE, N. W. B. *Buried pipelines; a manual of structural design and installation.* London, Maclaren, 1968. 309p. $18.00 (Aust.).

621.8672

This impressive book is likely to become the standard authority in its field for many years. It presents in concise form the fruits of some

seventeen years' research and deals with the all important problems of our times—namely the increasing crushing loads experienced under modern conditions, the particular circumstances of pressure pipes and pipelines, and the various technological innovations in flexible joints. The book ranges critically over the work and research of leading world authorities and in addition to a lucid discussion of the theory behind the formulae for estimating loads, gives many demonstrations of the application of the fundamental principles to modern practice. There is a most valuable section of worked examples, and there are numerous design charts, drawings and photographs.

FARMER, I. W. *Engineering properties of rocks.* London, Spon, 1968. 180p. $5.75 (Aust.).

624.151

The book sets out a simple and concise introduction to some of the physical and mechanical properties of rocks which determine their reaction as a structural material. From a basis of simple theory, it presents a largely empirical approach to rock properties which is especially planned for engineers and students meeting for the first time the increasingly academic field of studies known under the general heading of rock mechanics. The main topics of the book include physical properties of rocks, stress and strain, elastic and rheological properties of rocks, strength and failure, dynamic rock properties, testing procedures, effects of environment and macrostructure in massive rock, and criteria for design in rock.

HERMAN, Herbert, *ed. Advances in materials research. Volume* 3. New York, Wiley, 1968. 417p. $20.50 (Aust.).

620.112

This third volume of "Advances in Materials Research" presents contributions for both the specialist and general reader alike. It exemplifies the wide range of research activities in contemporary materials science.

CONTENTS: The continuum theory of dislocations; Fatigue hardening in face-centred cubic metals; The crystallography of artensitic transformations in alloys of iron; Properties calculations for heterogeneous systems; Lattice dynamics and the stability of crystals.

INSTITUTION OF ELECTRICAL ENGINEERS. *International conference on computer aided design,* held at the University of Southampton, 15-18 April, 1969. London, I.E.E., 1969 (I.E.E. Conference Publication No. 51). 683p. £11.0.0. stg.

Q.510.7834

This volume contains the papers presented at the first international conference on computer-aided design, held on 15-18 April at the University of Southampton, and organised by the I.E.E. in association with the I.E.E.E., the I.E.R.E., the I.Mech.E. and the university. C.A.D. is a new field and this is one of the first collections of reports from workers in the field. Subjects covered are classed into the following groups, each with an average of four papers. On-line graphics; mechanical design, circuit analysis, digital systems design, electrical plant design, electrical inter-connection, structures, conversational software, integrated circuits, plant layout, mathematical software techniques, on-line systems, automobile drafting, hybrids and central integrated design systems, mathematical techniques and device modelling.

INSTITUTION OF ELECTRICAL ENGINEERS. *Conference on switching techniques for telecommunications networks,* held at the I.E.E. London, 21st-25th April 1969. London, I.E.E., 1969. (I.E.E. Conference Publication No. 52). 482p. £11.10.0 stg.

Q.621.38

This conference was effectively the fifth of an international series held since the war, although "International" did not appear in the title. Sponsored by the I.E.E. Electronics Division, the I.E.R.E. and the I.E.E.E., there were fourteen conference sessions and 103 papers presented. The conference covered telegraphy and data (other than store-and-forward) and picturephone applications and also the nature of some of the failure mechanisms and certain aspects of software.

LEEMING, J. J. *Statistical methods for engineers.* London, Blackie. 1963, reprinted 1969. 146p. £1.0.0 stg.

519.92

This is a lucidly written introduction to applied statistics with examples mainly drawn from engineering problems. The book is addressed to all practising engineers who wish to learn how to apply statistical techniques to their work but, based on his own experience as a County Surveyor, the author writes particularly for highway and traffic engineers. For such engineers, statistical methods are an essential tool and they will especially appreciate the detailed numerical analyses included as illustrations of the relevant methods.

MCCAUSLAND, Ian. *Introduction to optimal control.* New York, Wiley, 1969. 258p. $12.60 (Aust.).

629.8

This book has been written in order to provide a simple introduction to the field of optimal control. The author has not attempted to provide advanced knowledge about any of the various specialized techniques available for optimal control, but rather to provide introductory information in general. The examples and problems are chosen to illustrate the various methods as simply as possible without becoming too much involved with computational difficulties. One of the principal aims of the book is ease of use and, as a guide to more advanced study, suggestions for further reading are included.

MADAYAG, Angel F. *ed. Metal fatigue; theory and design.* New York, Wiley, 1969. 425p. $16.75 (Aust.).

620.1123

This book offers a balanced treatment of the theories and design principles of metal fatigue. Causes and types of fatigue failure, mathematical theories of material behaviours, and the influence of processing and metallurgical factors on fatigue are discussed in the earlier part of the book, and are followed by a section on fatigue data interpretation and analysis on a statistical approach. Progressing through a comprehensive description of the various cumulate theories, treated individually and at length, random loadings are then analysed in relation to their associated responses, analysis, and measurements. The sections on design examine detail design and manufacturing considerations and study fatigue analyses and aspects of design as applied to fixed wing and rotary wing aircraft.

RICARDO, Sir Harry R. *and* HEMPSON, J. G. G. *The high-speed internal-combustion engine.* 5th ed. London, Blackie, 1968. 378p. £5.0.0 (stg.).

621.43

This authoritative book by one of the pioneers of the internal-combustion engine development has been thoroughly revised to include much new work on fuels, as well as developments in mechanical design. The original book had the distinction of being based almost entirely on the research work of the author or his laboratory, which resulted in a book of exceptional authority and clarity. In this revision the same principle has been applied.

ROBINSON, J. Lister. *Mechanics of materials.* New York, Wiley, 1969. 345p. $10.45 (Aust.).

620.11

This book contains a modern interpretation of time-tested theory, presented in a straightforward and classroom-proven manner, and developed sequentially to give continuity from chapter to chapter. In addition, chapters on beam-columns and stressed skin analysis are included as important modern aspects which are too often ignored in books on the subject of mechanics of materials. A short chapter on strain gauging is also included as an important experimental tool. The book has been developed for students of any engineering discipline, rather than specifically for "civil" students, although many of the classic problems are particularly well-suited to structural design. All students should be familiar with the material covered in the first six chapters; the remainder may be treated as a specialty subject.

SILJAK, Dragoslav D. *Nonlinear systems; the parameter analysis and design.* New York, Wiley, 1969. 618p. $24.10 (Aust.).

629.83

Written for engineers by an engineer, this book presents new analytical and graphical methods for parameter analysis and design of high-order nonlinear systems common in practical situations. The methods apply to both quantitative and qualitative aspects of nonlinear analysis. While the quantitative part is based upon the Krylov-Vovoliubov harmonic linearization and the describing function method, the qualitative analysis used the results of the Liapunov-Popov approach to system stability. Applying the proposed methods, the designer is able to choose parameters so that the nonlinear system has the desired response characteristics. Examples and problems for students are included in this book, which, besides presenting a new technique of interest to researchers, features numerous examples of high-order nonlinear systems valuable to the designer.

TRIPP, Basil H. *Renold Limited,* 1956-1967. London, Allen & Unwin, 1969. 188p. £2.5.0 (stg.).

621.8065

This is a history of the Renold Company during the past eleven years, and an account of the company's present-day structure. The book describes in some detail a modern, international (but British) technical product company at the opening of the computer age, and places it in the setting of changing technology and new management concepts characteristic of our era.

Book Reviews

(All books reviewed are available in the Library. The Dewey classification number is indicated at the head of each review.)

Hydraulic Control Systems, by Herbert E. Merritt. New York, Wiley, 1967. 358 p., figs. Price: $14.95.

621.2

The author of this book has attempted to cover most aspects of servo controlled hydraulic systems. The areas which have been dealt with include fluid properties, fluid flow, pumps and motors, servo valves, servo-mechanisms and control systems, pressure and flow control, and hydraulic power supplies. Some topics of considerable practical importance are not considered in depth as the coverage is very broad.

The sections on fluid properties, fluid flow, pumps and valves are very readable and would be useful reference for any engineers who are interested in fluid flow in industrial type hydraulic systems. In the section on servo-mechanisms and control systems it is assumed that the reader has a basic knowledge of control system theory. Terminology is clearly defined and problems of analysis are also fully explained.

The author has not given any numerical examples and often the reader is in doubt about the units used and the correctness of some of the equations—the Navier-Stokes equation on page 26 is an outstanding example. Insufficient data and factual material have been given for the book to be of great use to the designer.

For engineers in the machine tool, control, or industrial hydraulic field, the book will be a useful reference. It also provides a readable book for anyone wanting to learn something of the terminology, design tools, and problems associated with the specialised field of hydraulic servo control.

W.E.N.

The Analysis and Design of Pneumatic Systems, by Blaine W. Andersen. New York, Wiley, 1967. 302 p., figs., tables. Price: $13.50.

533

The author's aim is to "(1) explain clearly the basic mechanics of compressible flow, (2) to formulate general procedures for the preliminary evaluation and the detailed analysis of pneumatic components and systems, and (3) to provide the basic tools required to perform this analysis efficiently". Chapter headings indicating the arrangement of the material included are given as follows:—

Contents—An Introduction to Pneumatic Systems (very brief); Compressible Flow through Restrictions; Steady-State Analysis of Pneumatic Components; Transients in Elementary Pneumatic Systems; Applications in Industrial Process Controls; Design of a Pneumatic Actuation System.

The section on compressible flow is not as well explained as the author's aim would indicate and readers without a knowledge of this subject could find it difficult to follow. The approach is generally clear and logical and ample worked examples are used to illustrate main points in the theory. Tables and data, adequate to perform some useful calculations on most of the sections covered, are given. Unfortunately, there are no answers given for the test problems at the end of each section.

The book has insufficient data, etc. to make it a first-class reference book for the expert, and its specialised contents would make it unsuitable as a text for most engineering courses. However, clear exposition and many worked examples make it a very valuable reference for the engineer who, only occasionally, must estimate the performance of pneumatic components or systems.

W.E.N.

Australian and New Zealand Association for the Advancement of Science

Section H:

Members are reminded that papers presented before Section H of A.N.Z.A.A.S. may be submitted for publication in THE JOURNAL or one of the *Transactions*.

The conditions under which such a paper will be considered for publication are that before the meeting at which it is to be presented, The Institution is notified by the author that he will be submitting it for such consideration for publication, and that the author agrees that, on submission, it shall become the sole property of The Institution. If, however, the author omits to notify The Institution before presenting his paper, consideration may be given to its publication provided the author certifies that he has not submitted it to any other journal for publication.

Personal

Mr. K. J. JOHNSON, B.E., M.I.E.Aust., has been appointed an Associate Director of Clyde Industries Ltd.

"Look-in"

at the Division of Building Research, C.S.I.R.O., in 1970

In February, 1970, the Division of Building Research, C.S.I.R.O., Highett, Victoria, will open its doors to visitors from the building industries during a "LOOK-IN" arranged to show some of the research work currently in progress. The Division will, by then, have been established for 25 years, at first as the Building Materials Research Section, and later as the Division of Building Research. It is concerned with comprehensive research into inorganic and organic building materials, except timber, and with disciplines and functions such as operations research and economics, structural engineering, acoustics, and thermal performance of buildings. In the materials field the main activity is in concrete, gypsum plaster, ceramics, stone, plastics, and paint.

Instead of showing all the work in progress, as in previous Open Days, the "LOOK-IN" will comprise exhibits designed to present an overall theme:

"TODAY'S RESEARCH—TOMORROW'S BUILDING"

More than thirty exhibits are being prepared to develop the main theme under four headings:

Today's Research—Tomorrow's Planning
Today's Research—Tomorrow's Design
Today's Research—Tomorrow's Techniques
Today's Research—Tomorrow's Materials

Morning, afternoon, and evening sessions will be held, refreshments will be available, and parking will present no problems. A Guide to Exhibits will be ready in December, 1969, and those wishing to receive a copy should write to Division of Building Research, C.S.I.R.O., P.O. Box 56, Highett, Vic. 3190. The dates to remember are the 17th and 18th February, 1970.

Visitors to Headquarters

Mr. J. WEARING SMITH, B.E., M.I.E.Aust., of Melbourne.
Mr. W. H. HILEY, B.E., F.I.E.Aust., of Brisbane.

Deaths

The Council records with regret the decease of the following members:—

QUEENSLAND DIVISION	
Ronald Auckland LEACH	*Fellow*
SYDNEY DIVISION	
Felix CALWELL	*Member*
James FERGUSON	*Member*
David Gould POYITT	*Member*
Harry Doust WOLSTENHOLME	*Member*
VICTORIA DIVISION	
Arthur Leslie HARGRAVE	*Fellow*
William Cornelius MAHER	*Member*
Leslie Charles Baden PROFITT	*Member*

Obituary

SIR JOHN BUTTERS

The late Sir John Butters, C.M.G., M.B.E., who died on 28th July, 1969, was President of The Institution in 1927.

Born at Alverstoke, England, in 1882, he graduated with first-class honours at the University College, Southampton. From 1904-09 he was Assistant Engineer, Siemens Bros.' Dynamo Works Ltd., at Stafford, England, coming to Australia in 1909 as Chief Engineer for the Australian Branch of the company.

In 1912 he was appointed Chief Engineer and General Manager of the Hydro-Electric Power Company, Tasmania. In 1914 he established the Tasmanian Hydro-electric Department, later to become the Hydro-electric Commission. He was its Chief Engineer and General Manager until 1924 and that year he was appointed Chief Commissioner of the Federal Capital, responsible for the construction and organisation of Canberra to the point of transference of the Parliament and seat of Government.

In 1929 he retired as Chief Commissioner to enter practice as a consulting engineer in Sydney. He had been Chairman and Director of a large number of public companies.

He delivered his Presidential Address in Canberra in February, 1928, and it was due to him that The Institution was able to be the first national Institution to hold its Annual Conference in the national capital.

Membership

Admissions and Transfers

The following admissions and transfers were approved by the Council on 31st July, 1969.—

	Division.
Admitted as Fellow :	
IFIELD, Richard Joseph	S.
CHAN, Hong-Ching	S.
MEREDITH, Austin Joseph	V.
Admitted as Member :	
WILLSHIRE, Dennis Walter	C.
BUBB, Geoffrey Wilfred	N.
MCMAHON, James Gerard	N.
SLADDIN, Lindsay Alexander Dobson	N.
BENSLEY, Robert Owen	Q.
JEWELL, Stanley James	Q.
DAVEY, Graham John	S.A.
NEULING, Raymond James	S.A.
ARMES, Robert	S.
CALDWELL, Kenneth Jason	S.
HAUGE, Johannes	S.
KENNAN, Ross William	S.
LEE MOW WOO	S.
NELSON, Peter Ralph	S.
SMATEK, Michael Charles	S.
BARTLETT, Anthony Hugh	V.
GREENWOOD, John Edwin	V.
HANCORNE, John Arthur	V.
O'CONNOR, Harold Edward	V.
PROCTOR, Godwin Elela Singham	V.
QUESTED, Peter John	V.
ROBERTS, Stanley Bessell	V.
SZAKACS, Leslie	V.
EVERDEN, Michael Lance	W.A.
EVERETT, Daniel Brynmor	W.A.
HARTLEY, Richard Gordon	W.A.
MCKNIGHT, Francis Frederick	W.A.
Admitted as Associate :	
GILPIN, Alan	Q.
Admitted as Affiliate :	
ARUNDEL, Maurice Leonard	S.A.
BERESFORD, Frederick Donald	V.
Transferred from Member to Fellow :	
MORGAN, Robert James	S.
BARMBY, Bryan Desmond	V.
ZMOOD, Maurice	V.
ELLIOTT, Kenneth Watt	W.A.
Transferred from Graduate to Member :	
BALLANTYNE, Peter	N.
GOLDSTEIN, Peter John Paul	N.
OSIPOV, Eugene Alex	N.
BAGGIO, Orazio Teresio	Q.
BRAMELD, Gerald Humphrey	Q.
BYERS, Kenneth John	Q.
CASH, Ivan Joseph	Q.
DEARLOVE, Neville Benjamin	Q.
DOWLING, Kevin Francis	Q.
EATHER, John Herbert	Q.
FORTESCUE, Jeffrey Edward	Q.
FUSE, Thomas	Q.
HAY, Vincent Thomas	Q.
HUGHES, Robert Macdonald	Q.
LLOYD, David Howard	Q.
MUIR, David Lawrence Walker	Q.
NG, Thin Teng	Q.
POLLOCK, Norman Alexander	Q.
SPULER, Ernst	Q.
WILSON, Anthony	Q.
WOODS, Lloyd MacKenzie	Q.
ADAMS, Jeremy Sorby	S.A.
HICKS, Alan Edwin	S.A.
SCOTT, Geoffrey Frank	S.A.
WHYATT, David George	S.A.
BOWDLER, Keith	S.
MOORE, John Percival Henry	S.
STEPHENSON, Robert George	S.
GIBSON, Michael Slade	T.
BRAMLEY, Anthony Leon	V.
FISHER, Samuel Adamson	V.
GRANT, Royce Donald	V.
LEES, Raymond Paul	V.
LOR, Thong Jin	V.
MCILLREE, Brian Gordon	V.
MAHON, Bryan Patrick Garry	V.
NELSON, Brian Stanley	V.
OXLEY, Leslie John	V.
PETRIE, Robert William	V.
STREET, Raymond Ignatius	V.
TRAINOR, John Francis	V.
TURNOR, Trevor Victor	V.
UDVARY, Ferenc	V.
WAH, King Tze	V.
WEIR, Peter McGregor	V.
WIEBENGA, Alexander Edward	V.
WONG, Wing Chiu	V.
BLACK, James Greer	W.A.
CORNISH, Bernard Harold	W.A.
HARRIS, Lloyd Reginald	W.A.
KLIMAITIS, Vytautas Victor	W.A.
MILLER, John Edward	W.A.
OATES, Reginald John	W.A.
PORTER, Robert Powell	W.A.
Transferred from Student to Member :	
GUREVITCH, Richard Norman	C.
CLEELAND, John Edward	V.
FINCHER, Robert David	V.
MACKENZIE, Gary Raymond	V.
GODFREY, Leslie James	Q.
HACKETT-JONES, Francis Charles	S.A.
MCKITTRICK, Ronald Brian	S.A.
FORMENTIN, Alessio Luigi	W.A.
MOORE, Ralph Edward	W.A.
WALKER, John McAlpine	W.A.
Admitted as Graduate :	
HALYBURTON, Peter	N.
ANDREW, David Alfred Charles	Q.
BENHAM, Michael Alan	Q.
BOULTON, Neil	Q.
FAHY, Patrick William	Q.
FORDYCE, Lanny Drummond	Q.
GATLEY, Thomas William	Q.
HILEY, Edgar Peter	Q.
HOLLIS, Rodney Jack	Q.
HOW LUM, Colin	Q.
HUGHES, Jack Anthony Egan	Q.
MCELWAINE, Ronald Thomas	Q.
MORRIS, Kenneth John	Q.
NEILSON, Alfred Malcolm	Q.
PENNEY, Alan Charles	Q.
RAITI, Alfonso	Q.
SHIRRA, Garnet James	Q.
SWANSON, Raymond Percy	Q.
THORPE, David Stuart	Q.
VICKERS, Mervyn George	Q.
WRUCK, Paul David	Q.
GADILHE, Horst Werner	S.A.
BAKER, Roger James	S.
BUTCHER, Colin Frederick George	S.
CHAN, Martin Man Hin	S.
CONROY, Phillip John	S.
DE AMBROSIS, Laurence Peter	S.
EWEN, Garry Rae	S.
FAN, Too Pang	S.
KRONSTAD, Knut Andreas	S.
MORRISSEY, Thomas William Alexander	S.
PALM, Colin Duncan	S.
RAMADAN, Feisal Mahmoud	S.
ROZPORKA, Robert	S.
SPRIGGS, Kenneth Raymond	S.
SUE, Yee Hing	S.
ESHRAGHIAN, Kamran	S.A.
GEER, Dennis Keith	S.A.
JOHNSON, Neville Allan	S.A.
KNIGHT, Dennis Alan	S.A.
MARSH, Gregory John	S.A.
PHILLIS, Neville James	S.A.
JACKSON, Graeme Noel	T.
OWEN, Ronald John	T.
TURNER, Peter Vivian	T.
BARTLETT, Donald John	V.
BASSETT, Graeme Leslie	V.
BONOTTO, Giacomo Benedetto	V.
BRADSHAW, Eric Michael	V.
CALDER, Kenneth Edward	V.
CHARALAMBOUS, Constantine	V.

	Division.
COYLE, John	V.
FAKTOR, Michael	V.
FERGUSON, Ian Bryce	V.
FINDLAY, Albert John	V.
HAMMER, Hugh Ronald	V.
HARRIS, Roger Rees	V.
HEATH, Bruce Stoddart Andrew	V.
JONES, Robert Stuart	V.
KYRIAKOPOULOS, Lampros Grigoriou	V.
LAY, Douglas James	V.
LECHTE, Peter Anthony	V.
LIM, Whay Pang	V.
LONGMUIR, William Arthur Stuart	V.
LOWY, Peter	V.
MACHIRA, Isaac Reuben	V.
MEREDITH, John David	V.
MIDGLEY, Lance Howell	V.
NEEDHAM, John Lindsay Stafford	V.
POWELL, Robin Wayne Maurice	V.
ROBINSON, John Richard	V.
ROBINSON, Peter Henry Seymour	V.
RODDA, Bernard Francis John	V.
SCOTT-MURPHY, Richard Edward	V.
SEBIRE, John Colin	V.
SIPOS, Elemer	V.
TELFORD, John Philip Russell	V.
WILLIAMS, Peter Stewart	V.
WOLFENDEN, Peter Allen	V.
YOUNG, Raymond Alexander	V.
DILLON, Ross John	W.A.
GILLIES, Hunter David	W.A.
HARRINGTON, Richard Anthony	W.A.
HUGHES, David Trevor	W.A.
SEDDON, Laurence Noel	W.A.
UNG, Tea-kruy	W.A.

Transfer from Student to Graduate :

CLOUGH, Christopher Richard	N.
HAIR, Alan Ronald	N.
BARBER, Paul Douglas George	Q.
CONNORS, Reginald Clarence	Q.
DAVEY, John Pearce	Q.
DUNCOMBE, Maxwell Gordon	Q.
GILLESPIE, Allan John	Q.
HAWES, Henry	Q.
HOLMES, Gilbert George	Q.
LEVER-SHAW, Vernon William	Q.
MAHONEY, Terence	Q.
MALLON, Terrence Dermot	Q.
MATTHEWS, Benjamin Charles Henry	Q.
REAL, Graham Charles	Q.
SHIELD, Lester John	Q.
THURLOW, Michael Athol Hugh	Q.
TRACEY, Paul Anthony	Q.
WINTER, Arnold John	Q.
CHOW, Benjamin Ming Tung	S.
COWIE, John Raymond	S.
DAVEY, John Stuart	S.
DENHAM, David Roger	S.
GRAY, William Albert	S.
JOHNSTON, Gerard Raymond	S.
TOWNSEND, Anthony Alexander Richard	S.
YONG, Chee Yew	S.
COLLUM, Neil	S.A.
FLOOD, Frederick George	S.A.
JAMES, John Alexander Annandale	S.A.
MANNING, Andrew James	S.A.
REDDEN, Adrian Brian	S.A.
TOWNSEND, Peter Ian	S.A.
LOW, William Richard	T.
ALDERSON, Gordon Russell	V.
ARMOUR, Bruce Crawford	V.
BROWN, Keith Dickson	V.
BUGEJA, Anthony Lawrence	V.
CARTHEW, Geoffrey Allen	V.
CHATTO, Keith	V.
CHEA, Nai Fai	V.
COSTMEYER, Robbie	V.
COULTER, Robert John	V.
CRAWFORD, Gregory John	V.
CROSSLEY, Stephen James	V.
DONGOL, Shiva Shanker	V.
DYSON, Robert Spencer	V.
GRUFAS, Horst Werner	V.
HARGREAVES, Robert James	V.
HELMER, Harold	V.
HOULIHAN, Barry John	V.
KHO, Koey Tien	V.

	Division.
LOH, Ronald Wing Choon	V.
LYONS, Glenn Raymond	V.
MCDONALD, Ross William	V.
MCNAMARA, Brian William	V.
MORRIS, William Anthony	V.
ONG, Seng Teck	V.
PATON, Kenneth George	V.
PHILLIPS, Gary Raymond	V.
ROY, Geoffrey Grenfell	V.
RUSSELL, David John	V.
STYLES, John Richard	V.
TING, Pek Hua (Nicholas)	V.
WARD, David John	V.
WILSON, Ronald Gilbert	V.
WU, Wing-Hay Aloysius Joseph	V.
YOUNG, Alan Kenneth	V.
CHIENG, Liang Choo	W.A.
EVANS, Barry John	W.A.
MODRA, John Desmond	W.A.
MORLEY, Maurice Talbot	W.A
SCOTT, Anthony John Blondel	W.A
STURMAN, Jeffrey James	W.A.
TEA, San	W.A.
WANT, Frank Mark	W.A.

ENGINEERING CONFERENCE, 1970
MELBOURNE
16th-20th March, 1970

Inquiries should be directed to the Conference Organiser, The Institution of Engineers, Australia, 191 Royal Parade, Parkville, Vic., 3052.

Positions Vacant

(" Positions Vacant " advertisements must state a commencing salary or salary range, name of the employer and a definite closing date for applications. Advertisements which place any restriction on who may apply, will not be accepted.)

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, AUSTRALIA

APPOINTMENTS ADVISORY SERVICE

The appointments service of The Association of Professional Engineers, Australia, provides information on vacant positions to A.P.E.A. members seeking a position of greater responsibility and opportunity or who wish to gain wider experience.

These services include the notification of vacant position specifications by employers for cross-reference to the member's experience and requirements. Members selected from the Register then receive a personal letter setting out full details of the position.

A weekly digest of virtually all vacant positions advertised in national daily papers is available and information on some overseas positions is included from time to time.

Details of these services may be obtained from branch offices of The Association of Professional Engineers, Australia, in any State capital city.

UNIVERSITY OF SASKATCHEWAN

REGINA CAMPUS

FACULTY OF ENGINEERING

ACADEMIC VACANCY—INDUSTRIAL/MECHANICAL ENGINEERING

Industrial/Mechanical Engineering Professorship position from July 1, 1970, in a rapidly expanding new Faculty of Engineering with four departments. To plan and develop a Department of Mechanical Engineering having an industrial engineering (operations research) bias. Undergraduate and postgraduate programmes envisaged. M.Sc. or Ph.D. with industrial and teaching experience preferred. Salary commensurate with qualifications. Apply to Dean of Engineering, University of Saskatchewan, Regina Campus, Regina, Saskatchewan, Canada.

Closing date for applications: November 30. Professorship salary minimum $17,350 Canadian, with three annual increments of $550.

AUSTRALIAN ATOMIC ENERGY COMMISSION

RESEARCH ESTABLISHMENT, LUCAS HEIGHTS, NEAR SYDNEY

RESEARCH LEADERS—ENGINEERING

The Commission is seeking several senior scientists or engineers to plan, lead and participate in research and development related to heat removal from power reactors. The principal areas in which a large expansion is required in both basic research and technology are:—

- *Fluid Mechanics*: Fluid flow in coolant circuits, single-phase and two-phase pressure drop, hydraulic forces, flow distribution to main channels and cross-flow between sub-channels, turbulence, etc.
- *Dynamics*: Acoustic and flow induced vibrations in fuel elements, two-phase flow circuit instabilities, interaction with neutron processes, noise analysis.
- *Engineering Neutronics*: Effect of heat removal processes on reactor neutronic behaviour; nuclear methods of investigating coolant phenomena.

The Engineering Research Division has large well-equipped laboratories in modern buildings and access to two research reactors and large computers. Excellent service and workshop support is provided. In the long term the engineering laboratories will have technological responsibilities in support of the Australian Nuclear Power Industry added to its research role. In the meantime, until this industry develops, unusual opportunities exist for research in the fields listed.

These are senior positions and applicants should have a record of personal achievements in research and research leadership. Depending upon qualifications and experience the appointment will be within the grade of

PRINCIPAL RESEARCH SCIENTIST $8,313-$9,561

and consideration would be given to appointment of outstanding applicants in the grade of

SENIOR PRINCIPAL RESEARCH SCIENTIST $9,989-$10,301

Application forms may be obtained by 'phoning the Recruitment Officer on 531-0111 or writing to the Director, A.A.E.C., Research Establishment, Private Mail Bag, SUTHERLAND, N.S.W. 2232. Applications close 23rd October, 1969.

AUSTRALIAN ATOMIC ENERGY COMMISSION

RESEARCH ESTABLISHMENT, LUCAS NEIGHTS, NEAR SYDNEY

ENGINEERS—Class II

Applications are invited from experienced mechanical or chemical engineers interested in a career with the Australian Atomic Energy Commission. Duties may include design and development; project planning and control; and commissioning of plant. Experience in any of the following will be an advantage:—

NUCLEAR REACTOR DESIGN AND CONSTRUCTION
CHEMICAL PROCESSING PLANT
REMOTE HANDLING EQUIPMENT
INSTRUMENTATION
ELECTRO-MECHANICAL EQUIPMENT
EXPERIMENTAL PLANT AND EQUIPMENT

Applicants must have a university degree and/or Corporate Membership of a recognised engineering institution or equivalent.

Salary: $5,440-$6,094

Application forms may be obtained by 'phoning the Recruitment Officer on 531-0111 or writing to the Director, A.A.E.C., Research Establishment, Private Mail Bag, SUTHERLAND, N.S.W. 2232. Please quote reference M24. Applications close 23rd October, 1969.

ENGINEER—STRUCTURAL

Long established architectural practice requires imaginative design engineer to take charge of and develop an engineering section.

Commencing salary range $6,000-$7,000 p.a., but an associateship or even partnership is available to a suitable applicant on higher salary arrangements.

Applications should be received by 17th October, 1969.

FOWELL, MANSFIELD, JARVIS & MACLURCAN
87 BERRY STREET, NORTH SYDNEY, 92-4047

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS, NEAR SYDNEY.

ENGINEERING RESEARCH AND DEVELOPMENT

Vacancies exist for appropriately qualified applied scientists for theoretical and experimental investigations of heat removal from nuclear reactors. Applications are invited from persons with a background of experience in one or more of the following specialities, viz., heat, fluid flow, mechanics, dynamics, nucleonics, electronics, electrotechnology, control, measurements, etc.

The Research Scientist vacancies require a Ph.D. or equivalent together with proven research ability. Experimental Officer vacancies require a degree or diploma. Recent graduates are encouraged to apply.

Salary depending upon qualifications and experience will be within the ranges of:—

RESEARCH SCIENTIST	—$5,321-$6,693
SENIOR RESEARCH SCIENTIST	—$6,963-$8,045
EXPERIMENTAL OFFICER CLASS III	—$6,241-$7,003
EXPERIMENTAL OFFICER CLASS II	—$5,332-$5,989
EXPERIMENTAL OFFICER CLASS I	—$3,265-$5,118

Further information can be obtained from the Recruitment Officer by telephoning 531-0111, or by writing to the Director, A.A.E.C. Research Establishment, Private Mail Bag, SUTHERLAND, N.S.W. 2232, no later than 23rd October, 1969.

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS, NEAR SYDNEY.

POWER REACTOR PERFORMANCE ASSESSMENT

ENGINEERING AND PHYSICS GRADUATES

Vacancies exist for newly graduating or recently graduated engineers or physicists to enter the field of nuclear power reactor performance assessment. The work involves the analysis of the detailed nuclear and thermal behaviour of the core and has application to power plant assessment, operation and component design. The work is computer-orientated, making use of the Establishment's IBM 360/50 and both overseas and self-generated programmes. There is scope for developing new methods of analysis and for devising improvements in plant equipment. Under certain circumstances, original aspects of such work may be used to obtain a higher degree. Training in the sciences and techniques required will be provided as necessary, both by on-the-job guidance and by formal full-time courses at the Australian School of Nuclear Technology and by part-time post graduate study at local universities.

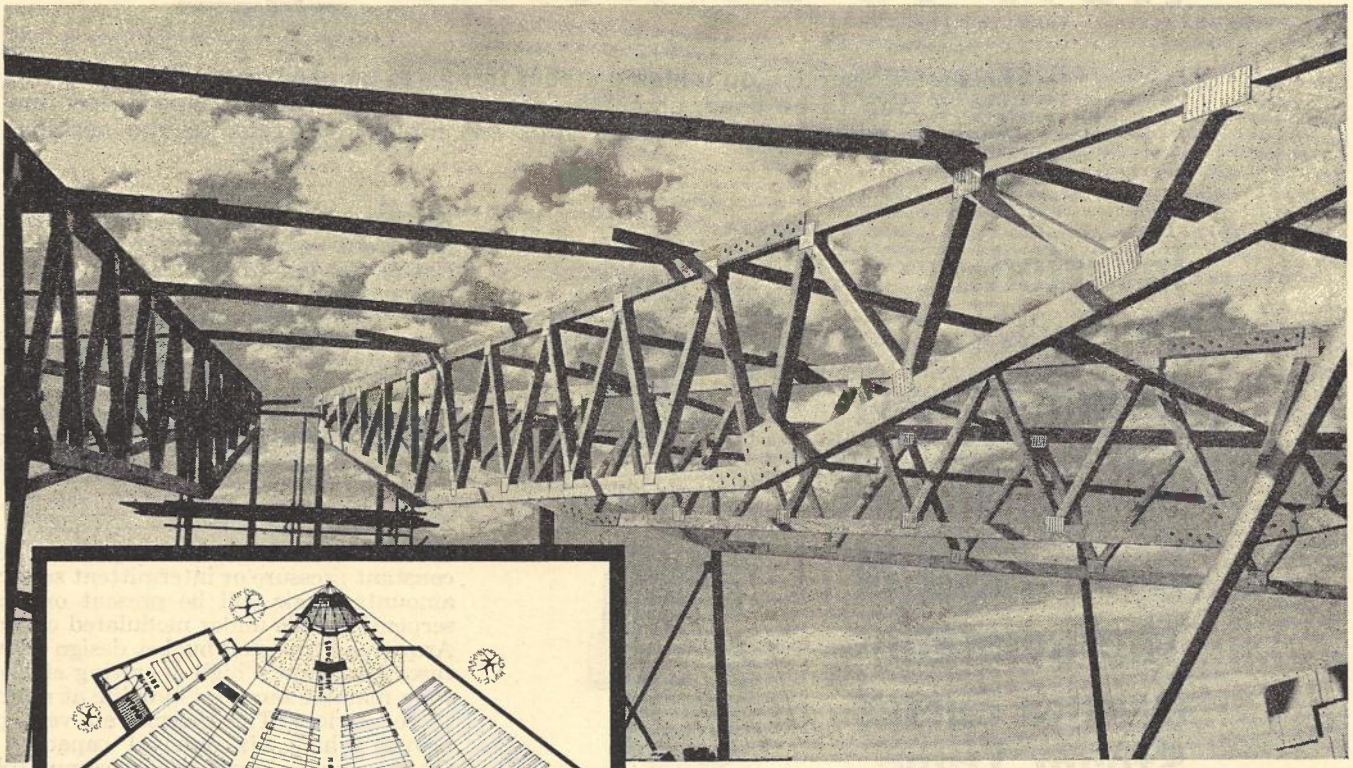
Vacancies exist at the following levels:—

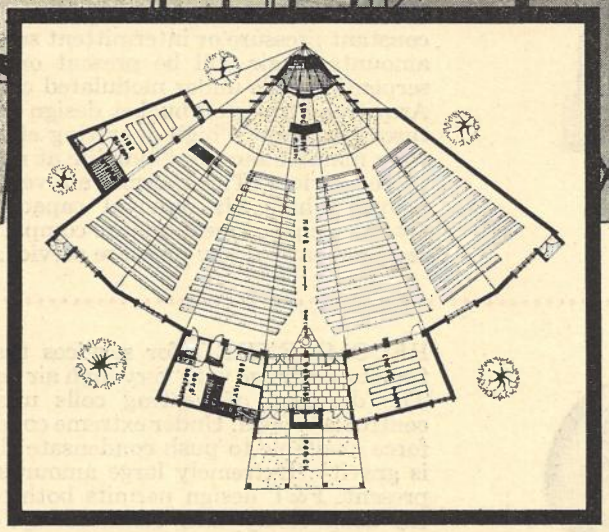
RESEARCH SCIENTIST	—$5,321-$6,693
EXPERIMENTAL OFFICER, CLASS II	—$5,332-$5,989
EXPERIMENTAL OFFICER, CLASS I	—$3,265-$5,118

Applicants for Research Scientist vacancies must have a Ph.D. or equivalent, together with proven research ability. Experimental Officer vacancies require a University degree or diploma.

Application forms may be obtained by 'phoning the Recruitment Officer on 531-0111 or writing to the Director, A.A.E.C. Research Establishment, Private Mail Bag, SUTHERLAND, N.S.W. 2232, not later than 23rd October, 1969.

INDEX TO ADVERTISERS





■ *Project:* St. Christopher's Church, Roberts Road, Airport West, Victoria. ■ *Client:* The Reverend Father John Phelan, Parish Priest. ■ *Architect:* Max Chester, B.Arch., A.R.A.I.A., 7 Hodgson Street, Heidelberg, Victoria. ■ *Builder:* Robert Owen & Son, Maltravers Road, Ivanhoe, Victoria. ■ *Roof Truss Fabricator:* Builco Pty. Ltd., 75 Main Road, Clayton, Victoria. ■ *Consulting Engineer:* Harry Van Veenendal, 30 Northcote Road, Balwyn, Victoria. ■ Trusses 6ft. deep, span 65ft., and support vinyl covered steel decking.

"Supply and Fix" tenders are available throughout Australia from competitive Gang-Nail Truss manufacturers listed below:

NEW SOUTH WALES: George Hudson Pty. Ltd., Glebe. **D. Hardy & Sons Ltd.,** Glebe. **Roof Trusses Pty. Ltd.,** Gosford, and Crows Nest. **Donoghoe & Hopkins Pty. Ltd.,** Queanbeyan. **Tanner Middleton Pty. Ltd.,** Concord.

VICTORIA: Builco Pty. Ltd., Clayton. **John Sharp and Sons Pty. Ltd.,** South Melbourne. **H. Beecham & Co. Ltd.,** Altona Nth. **V.I.A. Ltd.,** Airport West. **A. Dunstan & Sons,** Wodonga.

QUEENSLAND: Wilkinsons Timber Industries Pty. Ltd., Mt. Gravatt. **Rankine Bros.,** Malanda (Nth. Queensland). **Brandon Timbers Ltd.,** Virginia. **Hyne & Son Pty. Ltd.,** Maryborough. **Clark & Hanley, Kairi** (Nth. Queensland).

SOUTH AUSTRALIA: Globe Timber Mills Pty. Ltd., Port Adelaide. **Wadlow Pty. Ltd.,** Alberton. **Lloyds Timber Mills Ltd.,** Port Adelaide. **Chas. Geddes & Co. Ltd.,** Whyalla.

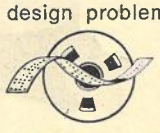
WESTERN AUSTRALIA: Australian Lumber Co. Pty. Ltd., Melville. **Douglas Jones Pty. Ltd.,** Guildford. **Bower Timber and Building Supplies Pty. Ltd.,** Esperance.

Design Freedom

In Australia and overseas the Gang-Nail connector plate has emerged as a valuable jointing medium for timber roof structures of every configuration. Today, through a network of authorised fabricators, Gang-Nail Trusses are being custom-built to meet the most exacting specifications of architects and engineers, particularly where total flexibility of floor space is essential. Clear spans of up to 100 feet are quite normal with minimum deflection and a high safety factor. On-site construction and supervision time are greatly reduced, contributing to all-over savings of up to 50% on similar steel truss systems. Excellent fire resistance, uniformity of roof line, and elimination of maintenance are further reasons for the dramatic swing to this versatile and highly practical method of roof construction.

The Gang-Nail organisation has a policy of complete co-operation with consulting engineers and architects to whom comprehensive Technical Design Manuals are available on request.

Gang-Nail engineers carry out a continuous programme of research and development. Qualified design staff are available to assist consulting engineers & architects with any design problem.



A General Electric Computer facility has been installed to furnish a fast accurate design service with computations whenever required. Gang-Nail Trusses are now approved by all building and lending authorities throughout the nation. Discussions on purely technical questions can be initiated with Mr. M. B. Shaw, Chief Engineer, Automated Building Components (Aust.) Pty. Ltd. See address and phone number below. Additional Technical Manuals will be supplied to approved professional engineers and achitects on request.

Gang-Nail Roof Trusses

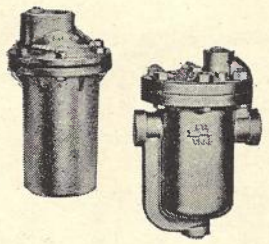
ABC1S

ABC Gang-Nail Connectors are manufactured by Automated Building Components (Aust.) Pty. Ltd., Kalimna & Highfield Aves., Springvale, Victoria, Aust., 3171. Phone 546 8866.

HOW TO EVALUATE Types of Steam

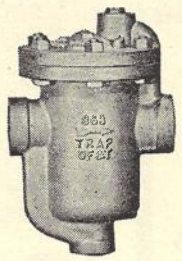
The specific service on which a steam trap is to be used should indicate the type of trap to be used, since the requirements of that service determine which individual trap characteristics are most important to the service.

Inverted Bucket Steam Traps



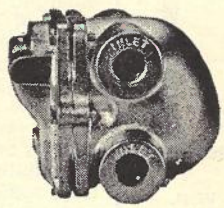
RECOMMENDED for all services where the most important requirements are overall operating efficiency, freedom from maintenance and long, trouble-free service life. By design, the Armstrong Inverted Bucket Trap operates without steam loss; simple, all-stainless steel mechanism assures long life and corrosion resistance; it handles dirt and operates against any back pressure less than inlet pressure; it vents air and CO_2 continuously and at steam temperature. It is the trap to use unless specific requirements of the service call for other characteristics.

Open Float & Thermostatic (Inverted Bucket) Steam Traps



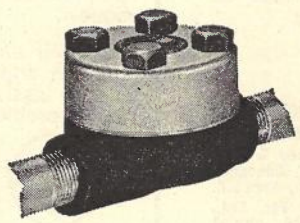
RECOMMENDED for low pressure (30 psi or less) constant pressure or intermittent service where large amounts of air will be present on start-up or for serpentine coils under modulated control. The basic Armstrong inverted bucket design provides the features that assure high operating efficiency, freedom from maintenance and long life at minimum cost for these services. The thermic air vent in the bucket provides high air removal capacity on start-up. Oversize pipe connections are compatible with piping requirements of low pressure service.

Float & Thermostatic Steam Traps



RECOMMENDED for services that require continuous drainage with very high air venting capacity. The drainage of heating coils under modulating control is typical. Under extreme conditions, the only force available to push condensate through the trap is gravity. Extremely large amounts of air may be present. F&T design permits both to pass through the trap freely and continuously. Armstrong all stainless steel float mechanisms and high quality thermal elements minimize the mechanical objections once held by some engineers.

Controlled Disc Steam Traps

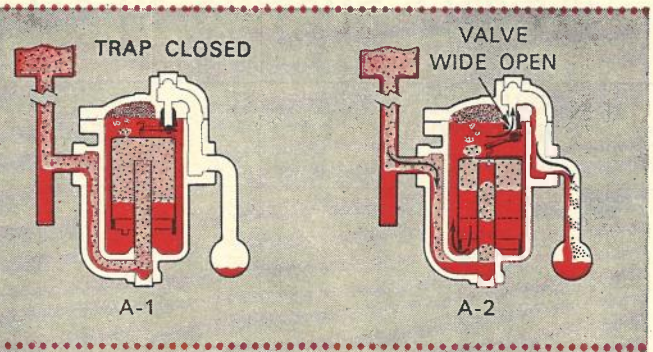


RECOMMENDED for services where small size, ease of selection for various pressures, ability to operate effectively on light loads and prevention of freeze-ups are primary requirements. The most common applications are tracer line drainage and dripping of steam mains outdoors. The Armstrong CD Trap meets all the specific requirements and, through the use of a steam heating chamber in the cap and a finite machined groove in the disc, puts operation under control for optimum trap life and maximum operating efficiency.

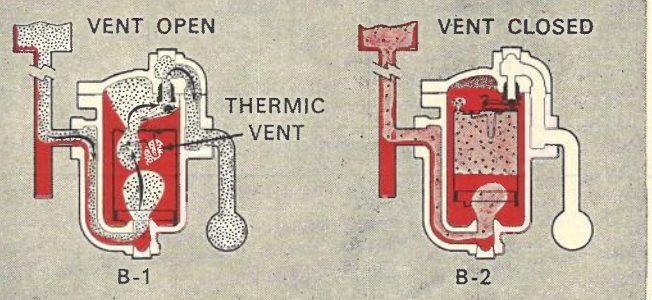
Traps to best answer your requirements

KEY: Condensate · Steam · Air · Condensate and Steam Mixture

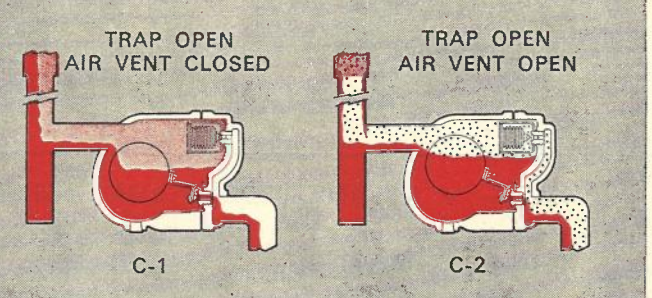
OPERATION OF THE INVERTED BUCKET TRAP is based on the difference in density between steam and water. The trap is closed when entering steam floats the submerged inverted bucket (see A-1 at right). The valve is held closed tightly by system pressure. Air and CO_2 entering the trap pass through the bucket vent and accumulate at the top of the trap. The trap opens when entering condensate causes the bucket to lose buoyancy (see A-2 at right). Weight of the bucket times leverage opens the valve. Air and CO_2 are discharged with condensate.



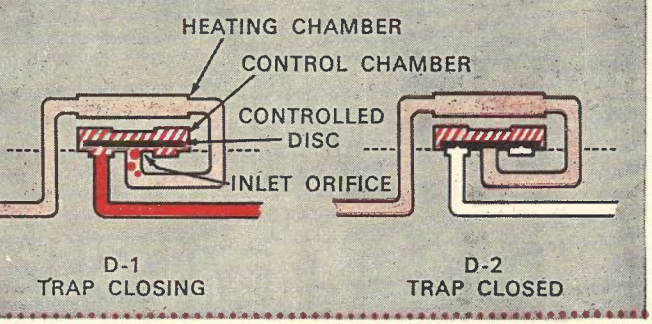
OPERATION OF THE O.F.&T. TRAP is identical to the standard inverted bucket trap except for the thermic air vent in the bucket. The function of this vent is shown at the right. When the trap is cool (B-1), air in the system passes through the wide open thermic vent. The bucket stays down holding the trap valve wide open. Air escapes rapidly until steam reaches the bucket (B-2). The temperature of the steam closes the thermic vent. Steam will then collect in the top of the bucket to impart buoyancy and close the trap valve.



OPERATION OF THE F&T TRAP is based on the difference in density between steam and water and the incondensability of air. Condensate lifts the float and opens the main valve sufficiently to balance the rate at which condensate accumulates. In the presence of steam (C-1 at the right), the thermostatic air vent is closed. Air from the system accumulates in the top of the trap (C-2 at the right). When its temperature drops a few degrees below saturated steam temperature, the balanced pressure thermostatic air vent opens and discharges the air.



OPERATION OF CONTROLLED DISC TRAPS is dependent on the changes in pressure that occur in the chamber where the disc operates. The Armstrong CD Trap will be open as long as condensate is flowing. When steam reaches the inlet orifice (D-1 at right), velocity of flow increases and the disc is pulled toward the seat. Increasing pressure in the control chamber snaps the disc closed. The subsequent pressure reduction, necessary for the trap to open, is controlled by the heating chamber in the cap and a finite machined bleed groove in the disc.



818-ST

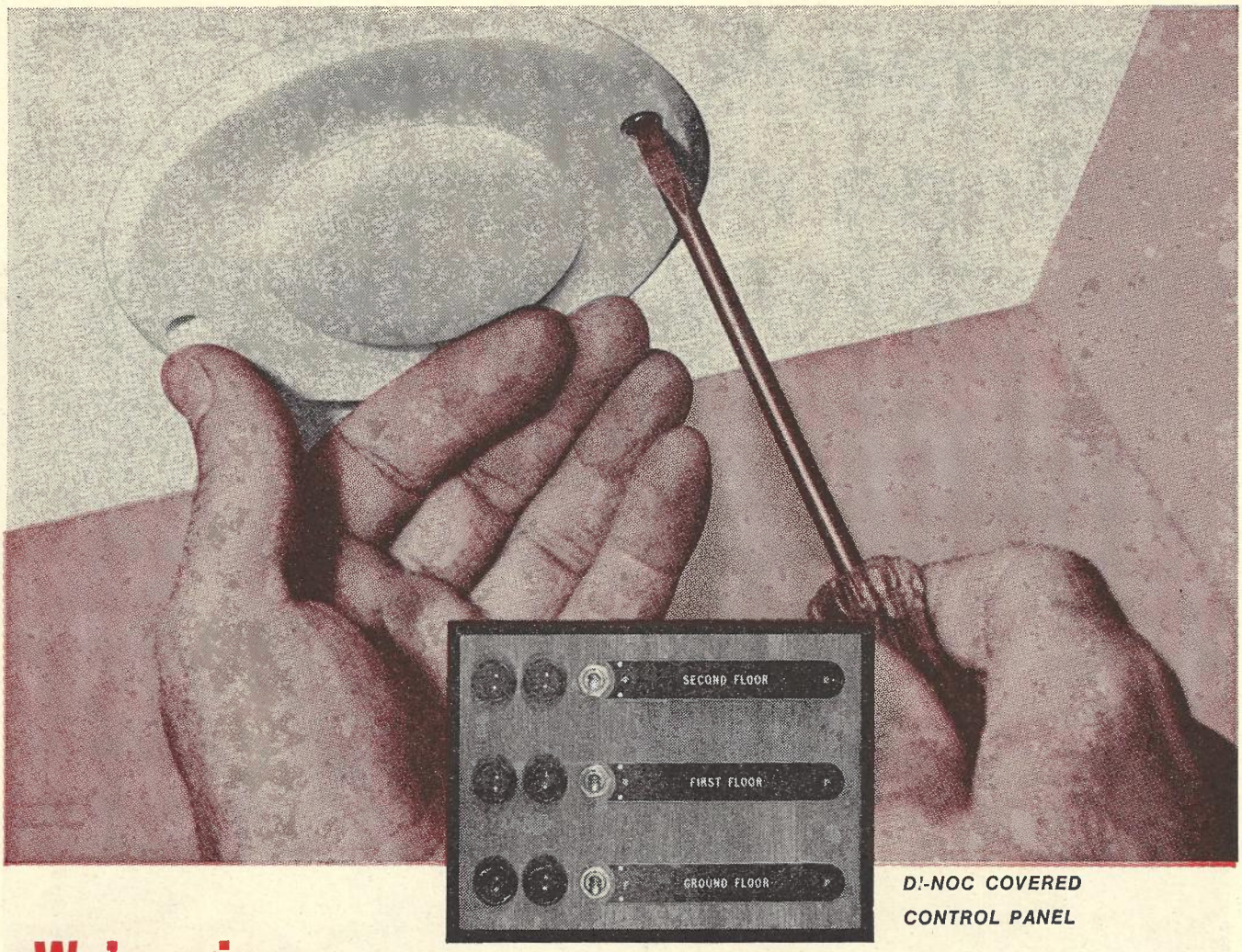
Want more detailed information?

Your Armstrong Representative can give it to you. Or if you prefer, write for the following descriptive literature that interests you:

The Armstrong Steam Trap Book—48 pages of data on inverted bucket traps. Ask for Catalog L.

Armstrong Controlled Disc Traps—Ask for Bulletin No. 108.

Armstrong F&T Traps—Ask for Bulletin No. 109 for industrial service, Bulletin No. 113 for heating service.



Di-NOC COVERED CONTROL PANEL

We've given fire detection a nice clean look

When your client wants fire protection included in the design, give him the clean look of the Wormald fire detection system.

With the Wormald system, gone are the old bulging fire detectors. In their place are the slim, low profile, Electro-Pneumatic detectors—smooth, functional units that perform just as smooth as the way they look.

These special Wormald detectors are semi-flush mounted and can be painted to fit into your designs in a complementary and yet functional manner. Should a fire ever break out in a building you've designed, these units perform the necessary detector functions with precise accuracy. Sound the alarm and alert the fire brigade through a special control panel—pinpointing the exact fire location.

But to make sure the whole Wormald system looks good all the way through, you can have the precision electronic control panels finished with the range of beautiful 3M Di-Noc woodgrain and pebble leather surfacing materials. Which means you can locate them in any prominent area of a building without spoiling the decor.

So if you want to give a client good, smooth-looking fire protection—contact Wormald Brothers. You'll find we've designed the Wormald system to do what good fire detection should do:

Keep your client's building the way you planned it. Beautiful and safe from fire.

WB

A WORMALD BROTHERS INDUSTRY

WORMALD ELECTRICS

A Division of Wormald Brothers (Aust.) Pty. Limited

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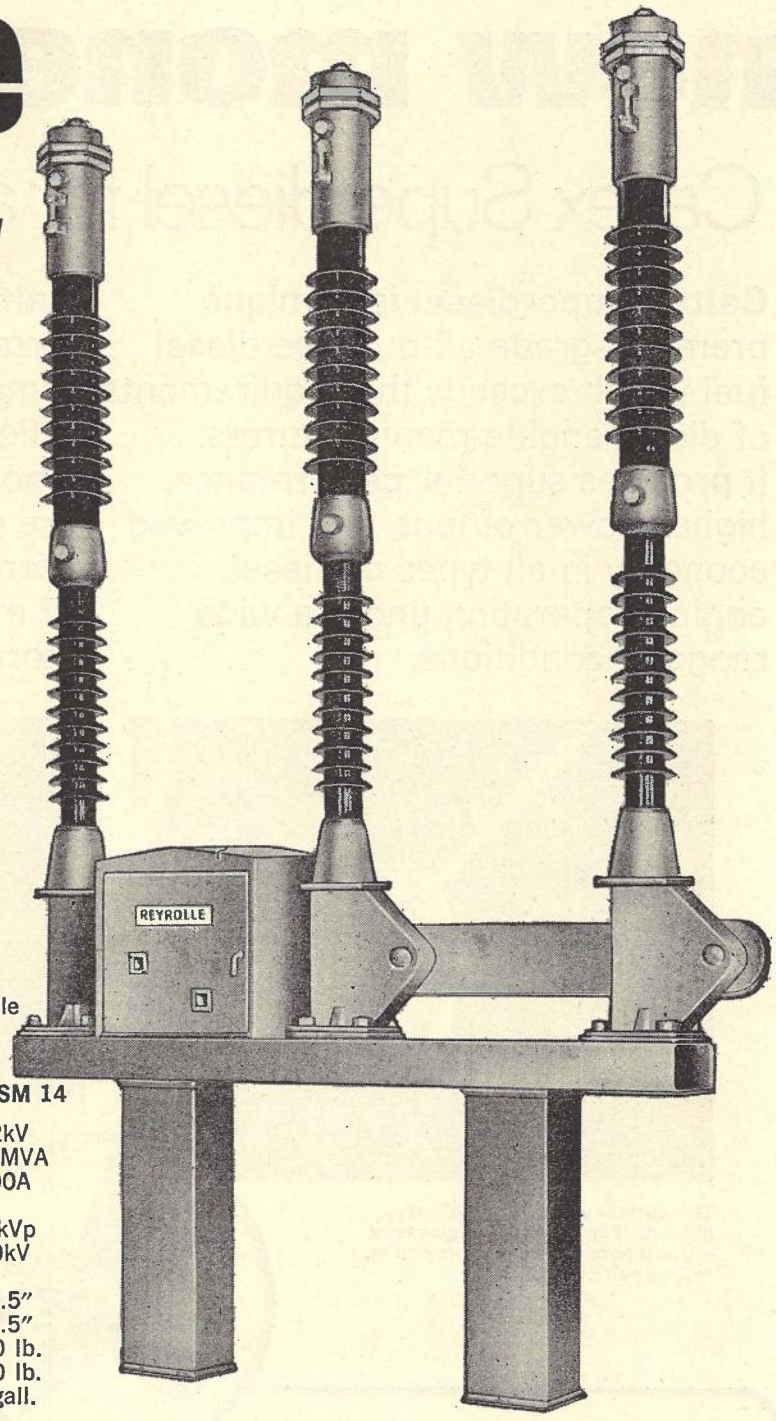
WB135.95

Reyrolle

66kV & 132kV
Small-oil-volume
CIRCUIT-BREAKERS

2500 MVA 1600 AMPERES
3500 MVA 1200 AMPERES
TO B.S. 116:1952 AND
I.E.C. 56:1959



Arc-control-device	Radial Vented
Operation	Closing: Motor-charged spring Tripping: Spring Maintenance: By detachable handle
Auxiliary switches	Standard: 12 Maximum: 24

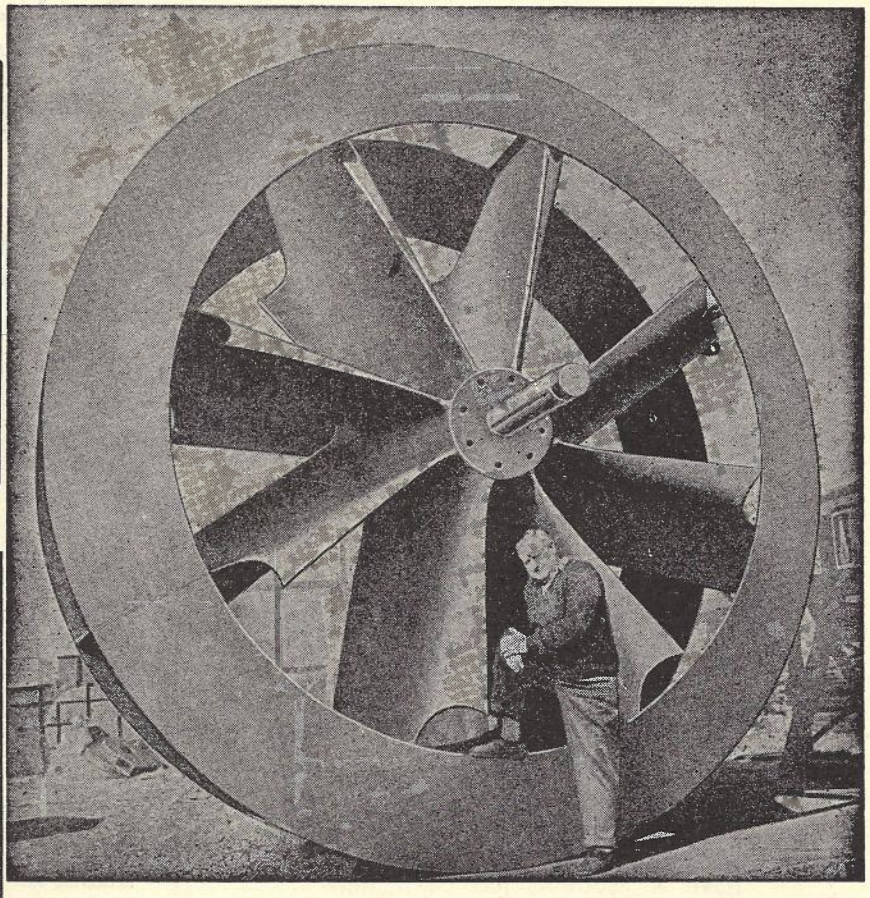
	Type OSM 10	Type OSM 14
Service Voltage	66kV	132kV
Breaking Capacity	2500MVA	3500MVA
Current Rating	1600A	1200A
Insulation:		
Impulse withstand	350kVp	650kVp
Power-frequency withstand	150kV	300kV
Creepage		
between terminals	51″	101.5″
to earth	52″	101.5″
Weight without oil	2453 lb.	6360 lb.
Weight with oil	2750 lb.	7180 lb.
Quantity of oil	33 gall.	90 gall.

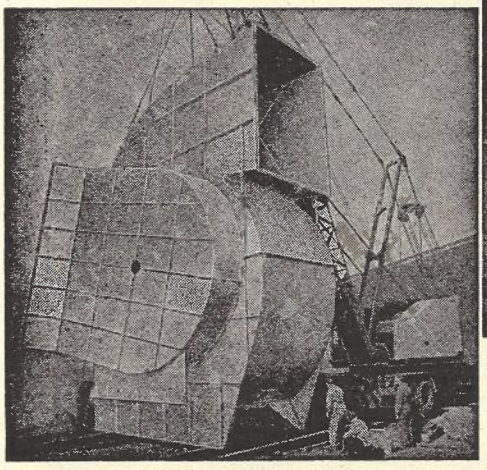
A. REYROLLE & COMPANY (AUSTRALIA) PTY. LTD.

HEAD OFFICE: Box 299, P.O. South Melbourne. 3205. 69-2271.
SYDNEY OFFICE: Box 431, P.O., Crows Nest. 2065. 439-1011.
ADELAIDE, BRISBANE, PERTH: Elder Smith Goldsbrough Mort Ltd.
HOBART: H. M. Bamford and Sons Pty. Ltd., Murray St. 7000.

R5724

Davidson made the Largest Centrifugal Fan in Australia





The casing of this fan is approximately 35 feet high and weighs about 32 tons. Completely fabricated in Australia, from heavy plate suitably stiffened, the casing was erected at the manufacturer's works to prove accuracy of fabrication, concentricity of suction eyes, etc. This is only one of many large fans being manufactured to the designs of Davidson of Australia who specialise in supplying high performance, high duty fans for the most onerous working conditions.

A 180 in. diameter centrifugal fan was designed and supplied recently by Davidson of Australia for handling 325,000 c.f.m. of flue gas at 600° F. from a Lead Sinter Plant. The complete fan was manufactured in Australia. Davidson of Australia can design and supply Australian manufactured fans for all industrial and power station applications and are backed by the research and development facilities of their U.K. Company which enjoys a world-wide reputation in fan and mechanical dust collecting equipment.

Above is a photograph of the almost completed 180 in. diameter impeller for the Lead Sinter Plant flue gas exhaust fan. Because of the comparatively high gas temperature and large shaft, a special bearing cooling system was designed which also eliminated water cooling of the bearings themselves.

TRADE SIROCCO MARK

DAVIDSON OF AUSTRALIA PTY. LIMITED

Victoria House, 11 Anderson St., Chatswood, N.S.W. 2067

Phone 41-2193 (3 lines) ***Postal Address: Box 150 P.O., Chatswood, N.S.W. 2067***

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