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"Mechanical Engineering Institutions in the UK, US, CA, NZ and AU"

by Andrew H. Wilson

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WORKING PAPER 6/1994

MECHANICAL ENGINEERING INSTITUTIONS IN THE UNITED KINGDOM, THE UNITED STATES, CANADA, NEW ZEALAND AND AUSTRALIA

by

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December 1994

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Abstract

This paper traces the origins, establishment and subsequent development - up until about 1970 - of the principal 'Learned' Societies in the discipline of mechanical engineering in four British Commonwealth countries and in the United States. It shows that, in terms of these three factors, the Societies fall into two groups, each with major common elements: the United States and Britain; and Canada, New Zealand and Australia. It also shows that all of them have endeavoured to change - and make changes - as the profession of engineering has evolved and as the technology associated with the mechanical discipline has developed.

About the Author

Andrew H. Wilson is a graduate mechanical engineer with training in economics. Currently a consultant in research policy and management, he served for almost 30 years in the Public Service of Canada. He has been President of CSME and of the Engineering Institute of Canada. He has also been Chairman of the Canadian Engineering Manpower Council and the Canadian Association for the Club of Rome. Some parts of this paper were presented at a Conference of the Canadian Science and Technology Historical Association and at a CSME History Committee Seminar.

About the Working Paper Series

In June 1991, the Board of Directors of the CSME agreed that its History Committee should be responsible for the production of a series of Working Papers on topics related to the history of engineering generally and to the mechanical discipline in particular. These papers may or may not be authored by members of the Committee or the Society. They will have a limited initial distribution, but CSME Headquarters in Ottawa will maintain a small supply of copies for distribution on request. These Working Papers may subsequently be published, in whole or in part, in other vehicles. But this CANNOT be done WITHOUT the WRITTEN PERMISSION of the CANADIAN SOCIETY for MECHANICAL ENGINEERING.

Introduction

I want to deal principally with the beginnings of the Learned Societies serving the discipline and profession of mechanical engineering in the UK, the US, Canada, New Zealand and Australia, and also with some of the later 'milestone' developments that took place up until about 1970. But in so doing I cannot avoid trespassing occasionally on the learned preserves of the civil and other disciplines and professions, and especially at their respective beginnings when practitioners tended to spread their interests across more than one of them. (1)

Kip Finch wrote:

> The immediate ancestor of the modern mechanical engineer...was the practical millwright. His activities date back to the late medieval times and the early Renaissance, when watermills and windmills were first used on an extensive scale to drive the grain grinders, saws, and other machines of a dawning industrial era. But the early 18th century in Britain marked the rise of new textile machines and an iron industry, which made metal available for the first time in a quantity and at a cost which permitted its use for purposes other than tools and fastenings. To these advances Watt added the new technique of steam power. A new engineering era, a new economy, and a new way of life were born. (2)

Engineers, like scientists, have usually been of a mind to discuss their work with colleagues and, to encourage these discourses, a variety of formal and informal means have been found over the years. For example, the Royal Society of London was founded in 1660 for this purpose, as was the Royal Society for the Encouragement of the Arts in 1792. These were formal Institutions. Less formal was the Society that John Smeaton founded in a London tavern in 1771 so that he and other like-minded men could discuss their work - engineering. This Society survived until Smeaton's death in 1792. It was later revived as the Smeatonian Society of Civil Engineers but, by 1817, had become exclusively a dining club. In 1818 a break-away group of younger engineers founded another professional Society, which became the Institution of Civil Engineers, a formal body that received its Charter in 1828. Its intention was to embrace all non-military engineering disciplines. Its early members included a number of distinguished mechanical engineers. In the United States, the Franklin Institute, which was founded in 1824, and the Boston Society of Civil Engineers, founded in 1848, encouraged debate on matters scientific and technical. In Canada, Sandford Fleming hoped that the Canadian Institute, which he helped to found in 1849 as a professional Society for engineers, surveyors and architects, would do this too. The Royal Society of Canada followed the Institute into the field in 1882. Similar developments occurred in Australia and New Zealand.

United Kingdom

The period between 1800 and 1850 saw the beginnings in the UK of economic sectors heavily dependent for their development on mechanical engineers, and included among these were the railway locomotive, textile, machinery and printing industries. Companies were founded and operated by mechanical engineers whose names even then were well-known - for example: Stephenson, Brunel, Whitworth and Maudslay. The development of railways, in particular, threatened the pride-of-place hitherto enjoyed by canals and encouraged canal owners to oppose railway construction. A split developed within the Institution of Civil Engineers but, as L.T.C. Rolt has pointed out:

> It is part of the folk-lore of engineering history that in 1846, only two years before George Stephenson's death....he applied for membership in the Institution of Civil Engineers but was told that he must comply with the regulations by submitting details of his professional experience and the signatures of supporting members of the Institution. The story is apocryphal. There is no evidence that Stephenson ever applied for membership, and in view of the historical background and character of the man, it is highly improbable that he could have done so. (3)

Nevertheless, the steam locomotive helped in the foundation of a new Institution. It happened that a small group of railway engineers met to witness trials at Bromsgrove, near Birmingham. A shower of rain forced them to seek shelter, and so began the discussions that would lead to the founding of the Institution of Mechanical Engineers on 27 January 1847, in Birmingham. Its main objectives were:

> To enable Mechanics and Engineers engaged in the different Manufactories, Railways and other Establishments in the Kingdom to meet and correspond, and by mutual exchange of ideas respecting improvements in the various branches of Mechanical Science, to increase their knowledge and give an impulse to Inventions likely to be useful to the world. (4)

One of those attending on 27 January 1847 was George Stephenson, who was elected the Institution's first President. He died in July 1848 and at the Annual Meeting held the following year his son, Robert, was elected to succeed him. However, the title of 'founding father' of the IMechE - as it is now so often called - was not a Stephenson but is considered to be James E. McConnell, the Chief Locomotive Engineer of the Bristol and Birmingham Railway. (5)

In 1849 William P. Marshall was appointed paid - but part-time - Secretary of the IMechE and held this position for the next 28 years. In 1850 he moved the Institution into its first permanent Headquarters on Newhall Street in Birmingham where there were meeting rooms, offices and a library. He helped significantly to guide the Institution through its crucial initial period, providing the kind of vigour and effort which Robert Stephenson believed to be necessary to overcome the tendency to 'languidness' in Learned Societies, as a result of which many of them had failed in the past. (6)

Marshall was also the first of several Secretaries of the Institution to serve

for a long period. Indeed, as a group, this has been among their most noticeable characteristics over the years. It has had both benefits and drawbacks, one of the benefits being stability within the organization, and one of the drawbacks being a reluctance to make changes.

Among the distinguished early Presidents of IMechE, in addition to the Stephensons, were numerous mechanical engineers whose contributions to the profession, the discipline and industry have become well-known. They include Sir Joseph Whitworth, Sir William Fairbairn, Robert Napier, John Ramsbottom and Sir William Siemens.

While Birmingham-based in its early years, the IMechE held its first meeting in London in 1851, to coincide with the Great Exhibition of that year. In 1856 a system of annual Summer Meetings in different cities in the UK was begun, the main objective being to expose both members and potential members not resident in the Birmingham area to the Institution and its programs. The first was held in Glasgow, and the second in Manchester, during which a statue of James Watt was unveiled. This Summer Meeting policy apparently helped to double the Institution's membership to 500 by 1863, as well as improving its financial base. In 1867 the first of several such Meetings was held abroad, this time in Paris, again taking advantage of an International Exhibition. (7a, 7b)

In 1877 the IMechE moved its Headquarters to London and the District of Westminster, where it has been ever since. The new quarters were more spacious than those in Birmingham. However, the downside was that Secretary Marshall chose to retire rather than move, and he was replaced by Walter C. Browne. An Assistant Secretary was also appointed. By this time, the membership had reached a robust one thousand. The following year the Institution was registered as a limited liability company, as a result of which the Council felt freer to take a number of initiatives. One of these was the appointment of a Research Committee of five Council members to advise on research into mechanical engineering problems which the Institution should support, and for which it should provide some funding. The results of this research were later discussed at the Institution's technical meetings.

In 1884 the Council decided that the level of duties of the Secretary now required that he serve full-time. Mr Browne, having concurrent private interests, chose to resign and was replaced by Alfred Bache.

In 1888 a Private Member's Bill - sponsored by the Society of Architects - came before Parliament. It proposed that those practising the professions of engineering, architecture and surveying should be required by law to register and that, after 1 January 1889, all entrants would be required to pass a qualifying examination. The Mechanical and Civil Institutions, the Surveyors' Institution and the Royal Institute of British Architects condemned the Bill and mounted a campaign to stop it on the grounds that what it proposed was contrary to public policy and that qualification by examination alone was not suited to these professions. The Bill was eventually withdrawn.

The Paris World Exhibition of 1889 again drew the IMechE to that city for its Summer Meeting. This was, of course, the occasion on which the Eiffel Tower was opened to the public.

By 1891 the membership of the Institution had reached 2,000. They were either Full Members or Graduates. The intermediate grade of Associate Member was introduced in 1893.

In 1895 the site for a new Headquarters at Storey's Gate, Westminster, was purchased and work began on the construction of the building. It was opened in 1899 and was subsequently extended several times. The IMech E is still at this same address.

In 1901 the Mechanicals, the Civils, the Naval Architects and the Iron and Steel Institute were active in founding the Engineering Standards Committee whose objective was to secure the standardization of the sizes of rolled steel joists and sections. The IMechE also handed over to this Committee responsibility for completing the work it had begun on pipe flanges.

The IMechE's first North American Summer Meeting was a joint one held in Chicago in 1904 at the invitation - and with the generous hospitality - of the American Society of Mechanical Engineers, and on the occasion of yet another International Exhibition.

The Institution formed its first overseas Branch at Calcutta, India, in 1909.

By 1912, and in spite of opposing the 1888 Bill, the Civil and Surveyors' Institutions and the Electrical one found it necessary to set up their own systems of examination for the admission to membership of younger candidates who did not already possess the academic diplomas that would make further examination unnecessary. The IMechE Council convinced the Annual Meeting that same year that it should follow suit with regard to the Graduate and Associate Member grades, and a system went into operation the following year.

In 1914 the IMechE began publishing a monthly Journal which would incorporate the quarterly Proceedings which it had published since the beginning.

During World War I, some 1,400 of the Institution's members served in the Armed Forces. Its Headquarters in Westminster were taken over by the Government and were not reoccupied until 1919. Also during the War, overseas Advisory Committees were set up in India and South Africa in 1915 and in Eastern Australia in 1918, the year before the Institution on that country was established.

In 1920, Edgar Worthington, the Secretary who had followed Arthur Bache and who had served for 23 years resigned for health reasons and was replaced by Brigadier Magnus Mowat. In view of the greatly increased work load at Headquarters, the Council took this opportunity to appoint two Assistant Secretaries. In this year, also, the formation of Local Branches at home was authorized by the Council. These were set up in the Midlands, Yorkshire, South Wales and the North-West during 1921, along with the West of Scotland Branch the following year and the West of England Branch four years later.

In 1921 the IMechE joined with the Board of Education (for England and Wales) in founding the system of National Certificates and Diplomas in Mechanical Engineering which served industry well for many years. As Parsons has pointed out in his book on the IMechE:

> The initiative came from the Board, who had approached the Institution as being 'the leading professional body concerned in this field of education work' with a request that (it) should appoint a small committee to discuss...the problem of devising systematic courses of study which would lead to the granting of certificates and diplomas to apprentices and students in engineering works. (8)

The Council welcomed this opportunity to bring reform to the uncoordinated technical education system and the small committee was formed. The Board actually had quite modest goals in mind but, under the influence of Dr H.H. Hele-Shaw (of pump fame), the system that was devised was extended to Scotland and Northern Ireland and became a national one with certificates issued jointly by the appropriate Education Authority, the educational establishment involved, and the Institution. For its part, the IMechE made holders of the Higher National Certificate exempt from certain requirements for election to Associate Membership. The system subsequently served the needs of other Commonwealth Institutes in determining the qualifications of certain of their applicants for membership.

Most of the first 36 Presidents of the Institution held office for at least two years but, from 1922 onwards, the term was limited to one year. Also in 1922 the Student grade of membership was introduced. The first lady to hold membership in IMechE was elected in 1924. Miss Holmes served as President of the Women's Engineering Society from 1930 until 1932.

Also in 1924, the Engineering Joint Council was formed. Its members were two representatives from each of the Civil, Mechanical, Electrical and Naval Architecture Institutions. Its duty was to examine and advise on matters brought to its attention by the 'parent' Institutions. However, the EJC was not part of a movement towards the unification of the engineering profession as a whole.

Th IMechE's River Plate Branch was formed at Buenos Aires in 1926. By that year, also, the Institution's membership had reached 10,000. At the Annual Meeting the question of making engineering a 'closed profession' like medicine or law was raised, but it received no support.

Throughout its life the Institution has received funds to endow many prizes, medals and lectures. Among the best known are the Thomas Lowe Gray Lectures and Prizes, which were first given and awarded in 1928.

In 1929 the IMechE was incorporated by Royal Charter, thereby raising its legal status from a limited liability company to that of a corporation representing what Parsons called 'the recognized embodiment of the profession.' The Charter itself was issued on 22 April 1930. The primary object of the Institution as defined in this Charter was 'to encourage invention and research in matters connected with mechanical engineering.' (9)

The 1932 Summer Meeting was held for the first time in Canada. It lasted a month - including the two Atlantic crossings - and involved visits to Quebec City, Montreal, Ottawa, Toronto, Hamilton, Brantford, Welland and Niagara Falls, as well as to Rochester and Schenectady in New York State.

In 1934, in order to facilitate the discussion of subjects which particularly interested members, the IMechE began the establishment of a series of Specialist Groups, the first of which was concerned with Internal Combustion Engines. The Education Group was formed in 1935, the Steam Group in 1936, and others followed.

In 1937 the Council organized a General Discussion on Lubrication. In all, the members of 51 British and foreign technical Institutes and Societies took part in the different sessions, whose average attendance was around 500. The complete set of papers and discussions from this meeting, plus the authors' replies, provided a synthesis of the knowledge of the subject at the time.

The James Watt International Medal was established as part of the Institution's celebrations of the bicentennial of Watt's birth with funds from a bequest by the late Sir Dugald Clerk. Since it was first awarded in 1937, this Medal has become truly international and prestigious. The Engineering Institute of Canada has been a co-nominator of several winners over the years.

In 1938, as the threat of World War II approached, the IMechE was asked by the Minister of Labour to assist with the preparation of a Register to ensure the supply of technical personnel for the Armed Forces, the Civil Service and industry. Also during 1938, Brigadier Mowat resigned as Secretary of the Institution due to ill-health. He was replaced on an interim basis by Mr J.E. Montgomery until his own retirement three years later, when Dr (later Sir) Henry Guy was appointed Secretary.

The 1939 Summer Meeting was scheduled to be held in the United States, but the imminence of World War II caused its cancellation. The War itself curtailed or modified the regular technical and social activities of the Institution, its Branches and Groups, although the normal services to members were maintained whenever possible. Some members of the staff joined the Forces. Paper rationing affected the output of the Proceedings and the other publications. But examinations continued to be held - sometimes during air raids, aboard Navy ships, in war theatres, and later on in prisoner-of-war camps. The IMechE assisted in the formation of a new Army Unit - the Royal Electrical and Mechanical Engineers (REME). The Education Group advised the Government on the education and training of engineers. By 1944 some, at least, of the wartime constraints on the Institution and its activities began to disappear. One of the most tenacious, however, was the lack of paper which persisted for several years after the war had ended. Instead of declining due to the hostilities, membership increased substantially, reaching almost 17,500 by the end of 1943 and 22,000 by the war's end. Over 6,000 members served in the Armed Forces or in direct Government employment. The Institution's Headquarters - several hundred yards from the Houses of Parliament - suffered no serious damage as a result of bombing raids on London.

In 1945, negotiations were taking place between the IMechE and the Institution of Automobile Engineers - which had been founded in 1906 - with a view to amalgamation. When this was finally accomplished two years later, the former members of the IAE became members of the IMechE's Automobile Division.

Also in 1945, the Institution received a generous bequest from the estate of the late James Clayton, the income from which was to be used 'for the encouragement

of modern engineering science' - and one-quarter of it for an annual prize. There would also be lectures, the first of which was delivered in October of that year by the winner of the first Clayton Prize, Air Commodore Frank Whittle.

1947 was the Institution's Centennial Year. Its membership was now at almost 29,000, and it continued to grow rapidly over the next quarter century. The IMechE's expansion problems were particularly acute because it had the largest membership of all of the UK Learned Societies in engineering and because its purview was broader and less specialized than the others. The Institution's staff was enlarged accordingly, as was its Headquarters. Additional Branches were formed in the UK and overseas, and the boundaries of some of the existing ones revised. Also, in 1949, in a spirit of cooperation with sister Institutions, the IMechE joined with the Civils and the Electricals to set up Joint Overseas Groups in areas where their memberships were thinly scattered, the first of which was formed in Abadan. At home, the Specialist Groups, which had been dormant during the war, were also revived, and their structure subsequently revised to take into account both the changing theoretical underpinnings and the new sub-branches of mechanical engineering.

Another postwar problem with which the IMechE had to deal was communication with its members in an atmosphere of increased knowledge and specialization. More conferences were organized - some of them internationally and some jointly with sister Institutions in the UK and abroad. A Conference of Commonwealth Engineers, for example, was held in London in 1954, and a later one in Australia, and a joint one on combustion was held in 1955 with the American Society of Mechanical Engineers.

Since 1847, the IMechE had published Proceedings, and since 1914 a Journal. The latter ceased in December 1953 and was replaced by a new magazine, The Chartered Mechanical Engineer, whose purpose - in addition to replacing the Journal as the source of Institution news - was to publish summaries of forthcoming papers and articles of general and historical interest. Several years later the need for a journal to cover the growing theoretical side of the discipline was met by the publication of the Journal of Mechanical Engineering Science.

The IMechE also turned its attention to the problems of attracting to the profession a larger share of the best young brains in the UK and of training young engineers. To help solve the training problem, the IMechE Council established a Committee to provide it with advice. Its report was issued in 1960, immediately after which a Working Party was set up to revise the Committee's recommendations to take account of the rapidly changing climate for training requirements.

In 1960 the structure of the Specialist Groups was radically revised. As Rolt has noted:

> Six groups were formed which together represent the foundations on which the profession of engineering now rests and for this reason they were termed 'horizontal' groups. The subjects they cover are: applied mechanics; theory of materials and construction; thermodynamics and fluid mechanics; automatic control; education and training; industrial administration and engineering production;

> lubrication and wear. In addition, there were eight groups described as 'vertical' because they represent the different specialized branches of engineering which have been built upon the 'horizontal' foundation. They are: hydraulic plant and machinery; internal combustion engines; manipulative and mechanical handling machinery; nuclear energy; process engineering, refrigeration, ventilation, and vacuum plant; railway engineering; steam plant. This is a flexible arrangement since it allows for the formation of new groups in both fields as the future development of knowledge and technique may require. (10)

In October 1962 a new organization in the engineering field held its first meeting. It included representatives of 13 of the leading Institutions and was called the Engineering Institutions' Joint Council. There were three main reasons for its establishment: confusion in the public's mind between science, technology and engineering; the need to attract to engineering more of the brightest youngsters; and the need for more unification among the many Institutions within the engineering profession. As noted above, a Joint Council of Institutions had been formed in 1924, but this step was not one designed to bring about unification. In 1928, in a paper read before the IMechE, John Barker had deplored the tendency towards the fragmentation of learned and other Institutions and Societies within the profession. By his reckoning there were at least 55 operating at that time. As well, the British Institutions considered themselves to be the 'gatekeepers' of the profession and - unlike their counterparts in Canada - were opposed to the idea of compulsory registration for engineers. Yet the amalgamation that had taken place in 1947 between the IMechE and the IAE had provided evidence that some reduction in fragmentation could be achieved. In August 1965 the EIJC received a Royal Charter and a new name - the Council of Engineering Institutions. It was able to grant the designation of 'Chartered Engineer' to the corporate members of its constituent societies which, in addition to the three that had formed the original Joint Council, included the Institutions of Chemical, Gas, Marine, Municipal, Production and Structural Engineers, the Institution of Mining and Metallurgy, the Royal Institution of Naval Architects, the Royal Aeronautical Society, and the British Institution of Radio Engineers. CEI activity included the development of a code of professional conduct based on the social and public responsibilities of contemporary engineers. It was also active in seeking to improve the standards of engineering design in Britain.

IMechE membership had, by October 1966, risen to just under 67,000 - almost double the figure for the Centennial year, 1947. However, by then the Council had become concerned that the annual rate of increase in membership had begun to slow down.

The Summer Meeting of the IMechE in 1967 was held in Canada, coinciding with EXPO 67 and the Centennial Congress of Engineers. The Institution's organization in Canada at that time included an Advisory Committee and several local ones which arranged meetings, visits and social occasions.

Also in 1967, a proposal was approved that re-designated Full Members of the Institution as Fellows (as distinct from Honorary Fellows) and Associate Members as Members, with the Associate Member designation disappearing altogether.

Graduate and Student grades, however, remained unchanged.

Sir Henry Guy retired as Secretary of the Institution in 1951 and was replaced by Brian Robbins who, in turn, retired in 1961 and was succeeded by Kenneth H. Platt. Platt was still in office in late 1969 when the unification movement took a further small step forward and the Institution of Locomotive Engineers (which had been founded in 1911) amalgamated with the IMechE. Its former members - and the members of the IMechE's Railway Engineering Group - became members of the IMechE's new Railway Division. As was noted at the beginning, the Institution of Mechanical Engineers in the UK was established in 1847 by mechanical engineers in the locomotive business. It is perhaps fitting that this section should end 122 years later with the Institution absorbing those in the locomotive business whose Learned Society had been operating for 60 years outside the IMechE.

United States

History was repeated in the United States in so far as the American Society of Civil Engineers - the first national engineering Society in the US - was founded in 1852, some 28 years before the American Society of Mechanical Engineers. But once again, the ASCE was not the first institution of the Learned kind associated with engineering in that country, having to yield - for example - to Philadelphia's Franklin Institute (founded in 1824), the Boston Society of Civil Engineers (founded in 1848), and to Engineering Societies and Mechanics' Institutes in a number of other major cities whose influence was local rather than national. Nor, apparently, was there a dearth of publications that dealt with mechanical engineering subjects. The Franklin Institute's Journal did so, as did the ASCE's Transactions and magazines such as the American Machinist and Railway Age.

History also repeated itself in that there was a railroad-cum-locomotive boom in the US before the ASME arrived on the scene in 1880. However, ASME's founders were a more broadly-based group than the one that founded the IMechE. They were associated principally with the utilities and the generation of power, engine design and construction, industrial production processes (such as steel), and the building of machine tools. Yet ASME was founded for the same basic purpose as IMechE - to encourage the mutual exchange of information and ideas that would contribute to improved professional performance and to innovation.

I should explain at the outset that this account of ASME's development - like the others in this paper - is quite short. Those who know ASME well will realize that much happened within, and to, this Society over the period between 1880 and 1970 which cannot be covered in this present context.

Of the origins of the ASME, Sinclair has written:

> Thirty of the most prominent men in American mechanical industry attended that first meeting of the ASME founders in the New York editorial offices of the American Machinist on 16 February 1880. They chose as Chairman the brilliant consultant to the American Bessemer Steel Association, Alexander Lyman Holley, and, characteristically, he provided a focus for the gathering, outlining

> both the intellectual boundaries of the mechanical engineering profession and the advantages to be derived from association. All the necessary steps to establish a new engineering society were taken at that meeeting... (11)

The formal organization meeting was held at the Stevens Institute across the river in Hoboken, New Jersey, on 7 April 1880, and about 80 attended. A governing structure for the new Society was discussed and rules adopted. Robert H. Thurston was elected the ASME's first President. For some years afterwards, the Society's Council managed its affairs, served as the Membership Committee, and published the Transactions.

Throughout ASME's initial development, two names keep cropping up either in support of, or opposed to, particular issues. These names are Holley - although he died at the early age of 50 in 1882 - and Thurston. The city of New York has also figured prominently throughout the Society's development. At the very beginning, the concentration of engineers in that city and the connections that senior members had with already-established engineering Societies - such as the American Institute of Mining Engineers - meant that experience was available to guide the leaders of the new Society. ASME has always made its Headquarters in New York. Beginning with the first one in early November 1880, and with only the occasional exception, the pattern emerged of holding Annual Meetings there and Spring (later Summer) Meetings in other parts of the country. An easy and repeatable pattern also emerged for the format of the Society's annual Transactions.

Sinclair has noted:

> From the outset, the Society had an intimate character. The number of members was small and the leading figures were remarkably alike in background. Alexander Holley had purposely balanced the first Council to represent the major branches of mechanical engineering, but the dominance of the machine builders in the early years was clear. They included those pre-eminent in the design and construction of pumping engines, such as Darwin Leavitt and Henry R. Worthington; Coleman Sellers of William Sellers and Company and Francis A. Pratt of Pratt and Whitney, two of the country's outstanding machine tool builders; and such well known power plant constructors as John E. Sweet and Charles T. Porter, both of whom had developed steam engines especially suited for generating electric power. Thus from the first, the organization was shaped by the style and concerns of men who possessed great mechanical ingenuity and considerable business talents, men who had come from the shop floor even though, more often than not, their families owned the firm...(12)

Sinclair has also noted:

> The American Society of Mechanical Engineers sprang to life...from a rich and varied institutional base, during a period of enormous vitality in the creation of national organizations for a myriad of special purposes, and at a time of great expansion in industries

> that depend on a high level of technology. These forces pulled men of varied backgrounds into the Society. Its early meetings reflected such disparate elements as the conversazione of European scientific societies, the mutual instruction of mechanics' institutes, and the applied physics of an emerging style of engineering science. Its membership mixed wealthy and powerful men in command of large enterprises employing hundreds of people with salaried superintendents whose managerial skills were called into existence by growing firms. These two groups constituted the majority of the membership, while the rest consisted mainly of professors of mechanical engineering and a few consulting engineers. (13)

Sinclair went on to say that the closely-knit quality of the first leadership of Society influenced the way the early Secretaries were chosen. The first, Thomas W. Rae, was related by marriage to Henry R. Worthington, and served from 1880 until 1882. He was replaced in 1883 by Frederick R. Hutton, who was then an Assistant Professor at Columbia University but had independent means. At first, Hutton himself rented the downtown New York office from which he, with help from his brother, administered the Society. He was the first Secretary to exercise executive functions. Hutton remained in this position until 1907 when he was elected President. He also wrote the first history of the ASME, which was published in 1915. Sinclair has noted that professional meetings - responsibilities of the Secretary - were identified early on as the most important of the Society's activities, and that a Secretary's success inevitably came to depend on his leadership qualities. But it was still the Council that exercised the actual power within the organization and it included men long accustomed to authority. In Sinclair's view, the relatively smooth transition from the idea of the new organization to its patterns of operation suggested that 'the community which called it into existence had a clear sense of its own needs and aspirations.' (14)

Two main themes can be identified in the development of the ASME, as Sinclair has explained:

> What ASME's founders distinguished as its social purpose and as its technical purpose became two great currents flowing through the Society's history. One expressed the application of rigorous training and specialized knowledge to the solution of technical problems. The other, a less natural analytical category, reflected the engineer's desire for social status and for political and economic power. Over the years these elements have been mixed in various and often contradictory combinations, and have assumed forms that differed substantially from one time to another. But perhaps in the way that the search for identity describes a kind of continual force in individual psychology, so the interplay of its social and technical characteristics has from the beginning defined the essence of ASME's nature. (15)

In the first ten years of its existence, the membership of ASME rose from 160 to 1,000, almost equal in size to the ASCE, which had had a headstart of almost 30 years.

As in the case of the IMechE in the UK, the ASME made its first sojourn abroad not long after its founding. In 1889, in company with members from the Civil, Mining and Electrical Societies, it visited Britain and France, the main attraction being the Paris Exhibition of that year. The Institution of Civil Engineers organized the hospitality for the visiting American engineers in the UK.

In 1890 ASME's financial position was sufficiently strong for it to purchase a building on West 31st Street in New York for its Headquarters. The facilities included an auditorium, a library, the Secretary's office, a small restaurant, and rooms on the upper floors that could accommodate overnight visitors.

But aside from the publication of the Transactions and out-of-New-York semi-annual meetings - and in a country the size of the United States - ASME had few attractions in its early years for those who lived away from NYC or lacked the funds necessary for travel. And in the social context, many engineers seemed to prefer their own city's Engineers' Club. In 1892, conscious of its need to attract many more members from beyond the Eastern US, the ASME held its Spring Meeting in San Francisco - but only 75 of the 1,440 Society members made the trip.

One of the early technical interests of ASME members was industrial standards - for example, for screw and pipe threads, flange dimensions for pumps, and boiler testing. Committees were formed and investigations undertaken, but the feeling was that the Society should not impose its will on industry through standards. Yet as Sinclair has noted:

> The maturation of ASME standards activity not only gave it intellectual respectability, but it also suggested a political role for that work within the organization. This possibility emerged from the desire to reformulate the boiler test code, which raised the notion of a permanent committee for codes and standards.....
>
> This sort of activity lent itself to widespread participation, or at least to the possibility of it. Standards brought the Society into cooperation with a wide variety of organizations and in closer touch with its own members. Committee reports, for example, included standard forms to be used by anyone who wished to forward results of his own experience in relation to the code. Thus, someone distant from meetings, and hesitant about contributing to written discussion to the Transactions, might still take a modest role in one of the Society's important technical programs. (16)

But before the codes work could become fully established, there was the 'revolution' that took place at the Annual Meeting in 1901. To the surprise of members who believed ASME's financial situation to be sound, to an outside world to whom ASME appeared successful in so many ways - and in spite of all its apparent advantages - the Society was actually going broke. A dues increase had been requested at the previous Spring Meeting, according to the rules, in order to meet increased operating expenditures, to fund research, and to publish more widely. While this was the apparent cause of the problem, the roots of the unhappiness among the Society's 2,000 members were the authoritarian way the

Society was being governed by the Council and the poor administration of its staff, the geographical imbalance of the membership, and the apparent indifference of those who enjoyed the facilities and companionship in NYC to those who lived and worked elsewhere. The dues increase was defeated by a three-to-one margin. The 'revolution' spilled over into 1902 before things calmed down again. Essentially, ASME had grown too big and its membership had become too widespread for it to function as a volunteer-led New York-based Learned Society. It had to become truly national and efficient, and its Council had to share power with centres outside New York.

It was not until 1905 that the Council passed a set of rules that would allow for the establishment of local Sections. Several unsuccessful attempts were made to start them over the next few years. Two of the sticking points were the financial and membership responsibilities of the Sections, and these were not fully resolved for many more years. However, in 1911, the report of a Special Committee paved the way for the successful establishment of Sections. In 1916 they were invited to suggest candidates for the Nominating Committee. In 1918 the whole nominating procedure was put into their hands, and the Sections themselves were grouped into Regions. One result of this development was that many future ASME Presidents had strong regional popularity.

But this gets ahead of the story of reform within the Society. One of the agents of change - and of the attempt to apply scientific management techniques to its operations - was Frederick W. Taylor. As Sinclair has written:

> The reform spirit thus achieved establishment status in 1906 with Taylor's election (to President). Taylor was the ideal person to lead a movement for the regeneration of the Society. A Vice-President since 1904, he enjoyed an outstanding technical reputation, a secure social position, wealth, and energy. Furthermore, it had become obvious that the Society's affairs were badly handled. Hutton, using methods essentially unchanged since 1883 when he had become Secretary, enjoyed the sense of controlling the Society's affairs and it was not easy for him to delegate authority. But Committee and Council members were sometimes glad to have him do their work, and that also prejudiced the effective administration of the institution. Furthermore, Hutton already had a full-time professorship at Columbia University and that further reduced his ability to manage an increasingly complex organization. (17)

To help him, Taylor appointed a special assistant, Morris L. Cooke, a mechanical engineer and scientific management disciple. For his part, Hutton must have anticipated Taylor's election since it was usually possible for 'insiders' like him to do so for most future Presidents. So Hutton decided to retire as Secretary and announced this at Taylor's first Council Meeting - which put the new President on the spot. His solution was to have Hutton nominated as his presidential successor. But this also required the appointment as Hutton's secretarial successor of someone sympthetic to Taylor's ideas. The choice was Calvin W. Rice, an electrical engineer and ASME member, who became Assistant Secretary and Secretary-Designate in June 1906. He worked closely with Taylor and Cooke to implement reforms. Rice had earlier been instrumental in helping

persuade Andrew Carnegie to donate the new United Engineering Societies Building on West 39th Street, into which the ASME moved from its West 31st Street Headquarters in 1906.

In the longer run, however, the implementation of Taylor's reforms did not go so well for the Council or the Society as a whole. Some of them - such as the new accounting procedures - cost the Society more money than before, and the staff generally had to be increased. Taylor warred with some Council members, and Cooke turned out to be more outspoken than his position allowed. Yet he was innovative. In 1909 he tried to have ASME sponsor a national conference on air pollution. The idea was killed by a Committee made up principally of New York members, as so many of the ASME Committees were. But even Taylor realized that, for Committees to get their work done, the majority of their members must be within easy travelling distance of the Headquarters.

Rice, for his part, did what he could to smooth the opposition to reforms and to keep ASME's operations going. And not only was Taylor succeeded by Hutton as President, his main conservative rival on the Council - Jesse Smith - was nominated for this office in 1909. Yet, while not all of Taylor's reforms were successful, they were - in spirit - more in tune with the thinking of the younger members of the Society than with the supporters of small-group decision-making that had been the previous practice. As Sinclair has noted:

> ....the men who flocked in such numbers after 1900 to join engineering Societies did not own factories - they worked in them; and although most of them shared the values and objectives of their employers, they sought an independent occupational identification. Taylorism, by its emphasis on applied science and social purpose, indicated one way these new bureaucrats of the urban industrial complex could still satisfy the sense of self-governing professionalism. (18)

In regard to membership, ASME had just under 4,000 members in 1911. Their number had reached 7,000 by 1914.

In 1911 the ASME Council appointed John A. Stevens of Massachusetts as Chairman of the Boiler Code Committee. In 1913 the Committee sent out copies of its preliminary report for comment, and another report in 1914 which met with stiff criticism. Yet another was submitted to the 1914 Annual Meeting for discussion. It was followed by a final draft of the First Edition of the Code shortly thereafter. From then on, the Boiler and Pressure Vessel Code work of the Society occupied a key place in its roster of activities. ASME also came to derive a significant part of its annual income from the sale of documents associated with the Boiler and Pressure Vessel Code.

Morris Cooke was a thorn in the flesh of the ASME Council for several years around this time, although he served as a member of it only in 1915. His main concern was the Society's 'social economy' and problems such as the geographical imbalance of the membership as a whole, the undemocratic nature of its structure, and the question of professional responsibility. His major opponents were the power utilities and the grip of their senior people on the affairs of the Society.

Around 1915 the ASME became concerned about the founding of rival organizations when fewer than one-quarter of all American engineers belonged to the national Learned Societies. For example, in that year the American Association of Engineers was founded in Chicago with a mandate to respond to problems employee engineers were having in regard to their welfare, rather than to the need for technical information, and to the problem of the lack of public recognition. Its peak membership was over 20,000, but its lifetime was relatively short. Earlier, on the technical side, the heating and ventilating engineers had established a national society, and ten years later the refrigeration engineers had done the same. The Society of Automotive Engineers had been founded in 1905 to rival ASME in this growing field of mechanical endeavour. In response, the ASME formed a Committee on Affiliated Societies in December 1907, as a result of whose deliberations the Gas Power Section was formed. It was a success, with several Committees and a nation-wide membership of one-tenth of all ASME members. But it took several more years for the Society to grasp the 'nettle' and formally establish specialized technical groups. Much of the resistance to them came from the Society's leaders. At first the Council ruled that all special technical interest groups would be sub-committees of the Meetings Committee. In 1912, for example, sub-committees were formed on air machinery, fire protection, industrial buildings and railroads, and in 1914 the Gas Power Section became another. Not all of them lasted long. However, in 1919 the Council finally authorized the formation of Technical Sections. Those created the following year included aeronautics, gas power, industrial engineering, railroads and machine shop. They were watched over by a Committee on Professional Sections.

By 1920, due in part to the formation of Local and Technical Sections (or Divisions) and the influence of World War I, ASME's membership had climbed to 13,500. Yet as Sinclair has noted:

> Against this appearance of dramatic difference...some fundamental things remained the same. The terms of employment of most of the Society's members were unchanged; despite the attention given to public affairs, most members still worked in industrial bureaucracies. The geographic balance of the Society had not changed - the great increase in membership had not by 1920 significantly altered the percentage of members based in New York. And notwithstanding new nomination procedures, in practice a small group of men in ASME still controlled the knowledge of its workings and made the most important decisions about its policies. (19)

ASME's interest in research, however, was boosted after the War when a Special Committee was formed to coordinate an expanding array of research projects and, within a decade, had raised and spent $200,000 to conduct them.

1930 saw the ASME celebrate its Golden Jubilee in style - in spite of the adverse economic circumstances of that time and the criticismm that was being levelled at science and its applications. The Society chose to hold part of the celebrations in Washington in April and to invite numerous foreign experts to participate. At the time, the occupant of the White House - Herbert Hoover - was an engineer. There were also celebrations in New York and an extravagant pageant was performed at the Stevens Institute in Hoboken, New Jersey.

The ASME, along with the Civil, Mining and Metallurgical, Electrical, and Chemical Societies, and the American Society for Engineering Education initiated steps that led to the founding in 1932 of the Engineers' Council for Professional Development, in which the Engineering Institute of Canada and the (US) National Council of State Boards of Engineering Examiners were invited to participate. The main objective of the ECPD was 'to promote efforts toward higher profesional standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems.' The ECPD became the agency charged with accrediting Engineering Schools in the US and provided a forum for engineering educators and industrial representatives to interact on education matters. (20)

Meanwhile, since the end of the 1920's, the Society had been suffering from a decline in membership and the Technical Divisions from a need for subject review and proper recognition. The latter had led, for example, to some strident demands to the Council from the Mid-Continent Section in Tulsa, Oklahoma, for action over the activities of Societies competing with the Petroleum Division. On this the Council did indeed take some action. During the Depression, however, the difficulties of the Technical Divisions and the Society, generally, continued. And during the mid-thirties the Divisions were strongly criticized by W.H. Carrier, the air conditioning engineer, who maintained that they had been organized on an incorrect principle and had proved faulty in practice.

In 1936 the Divisions were reorganized into five departments: basic science; power; transportation; manufacturing; and management. However, further criticism came from a departing staff member - Pierce Wetter - who had just completed ten years of responsibility for the Technical Divisions. And it was reported to President Hanley in 1941 that - instead of rejoining ASME (after having dropped out during the Depression) - many of the members of the Machine Shop Division had since become members of such groups as the American Society of Metals or the American Society of Tool Engineers where they thought they would receive more professional information and education than they had ever obtained from their membership in the ASME.

The Depression Years also had a negative influence on engineers in general. They were blamed for the economic mess the country had gotten into. As Sinclair has noted:

> These assaults were particularly galling since, among professional groups, engineers were hit hardest by unemployment because of retrenchment in manufacturing and the capital goods industries. The Depression also served to remind them of the anomalous nature of their calling. America's industrial capability depended on their specialized knowledge, yet they tended to occupy subordinate positions in the industrial hierarchy. Furthermore, while it seemed evident that the same combination of technical and organizational skills that had wrought such miracles of production were precisely those needed to solve the Depression's problems, their lack of real power provided another reminder of an often marginal status. As Arthur V. Sheridan put it in a letter to Ralph Flanders, 'The engineer has created modern society but has not been permitted to administer it.' (21)

In December 1933 the ASME Council suspended John C. Parker from membership. A businessman and engineer, Parker's problems with the Society began with the Boiler Code in 1914. As a maker of boilers, Parker bitterly resented the Code as an intrusion of his business amounting to sabotage. Another problem was Parker's publication of a highly profitable handbook, for whose production he believed the Society should provide support. He wrote letters to the ASME membership. The nub of this problem was that some members had used their connections to the Society for commercial advantage and Parker believed he should also be able to do so. The Council disagreed. In 1933 Parker launched a suit against the ASME and its new Secretary, Clarence E. Davies, who had recently replaced Calvin Rice. This was the beginning of a long and vexing legal battle whose details need not concern us in this paper.

The ASME began the 1930's with a membership of 20,000, but the number fell during the Depression and it was not until the last year of World War II that this figure was reached again. The War itself unleashed the talents of the engineering profession once again in the job of supplying the materials needed to pursue it to a victorious conclusion. And this successful marshalling of the scientific and technical resources of the US gave the professionals who were involved a confidence that was carried forward into the peacetime years that followed. But peacetime brought new pressures for technical and other activities and services within, and on behalf of, the Society.

In 1946, as part of the first reorganization of the Society in the post-war period, the Council created seats for eight Regional Vice-Presidents. This step helped recognize the value of the far-flung membership and the Local Sections in supporting the ASME through the difficult times of the 1930's and 1940's. But it did nothing at this time to increase the political power of the Technical Divisions in the upper management of the Society.

The 1950's and 1960's added new technical challenges, some of them related to small-scale wars or to threats of much larger ones, as well as to a general improvement in economic well-being. For ASME, they were decades of significant growth and change, both in the way the Society governed itself and in the numbers and the character of its membership which was, by then, dominanted by employees - rather than employers - who were struggling with the problem of the engineer and his social and technical responsibilities. One manifestation of this was the establishment in 1968 of a Standing Committee on Technology and Society.

Two other changes should be noted. In 1957 Clarence Davies retired as Secretary of ASME and was replaced by O.B. Schier, who served in this capacity until 1972. In 1961 the ASME moved its Headquarters in New York from West 39th Street, where it had been since 1906, to the United Engineering Building which had been erected on the United Nations' Plaza.

A constitutional revision process - called 'Restructuring' - was undertaken by ASME in 1966. Its motivation - but seldom acknowledged - motivation was the redressing of the balance between geographical and technical representation on the Council. It was also stimulated, Sinclair noted, 'by America's sense of world power, on the one hand, and on the other by the social and political turmoil of the 1960's in the United States.' (22)

The Chairman of the sub-committee of the Committee on Organization that was studying the matter - Louis Rowley - preferred to explain it as the redefinition of role of the Headquarters staff. As Sinclair put it:

> Rowley drew a distinction between 'policy,' which he reserved for the membership, and 'operations,' which he made a staff function. Yet he did not mean to limit the staff role only to one of support service to the membership, any more than he meant to limit staff size. Members might still think of New York employees in those restricted terms, but Rowley argued for a greatly expanded Headquarters operation, which at its senior level 'made the member role purely a policy-setting and advisory one.' And just a Frederick Taylor had sixty years earlier, Rowley justified the increased cost of these extra administrative layers by claiming they would generate more revenue for the Society. (23)

The solution was a set of new Policy Boards, each with its own Vice-President to administer the Regions, Technical Divisions, Codes and Standards, Education, Communications, and Professional Affairs. The Divisions, therefore, and at long last, achieved representation on the Council. At the same time, a set of parallel staff directors was created which formalized what was actually current staff practice. So symmetries were created between membership and staff, as well as between technical and geographic interests.

By 1970 the ASME's membership was approaching 80,000 - a four-fold increase since 1945.

Finally, mention should be made of ASME's 'Goals' Conference held in January 1970 at Arden House in Harriman, New York. This Conference originated from three principal concerns: the need for long-range planning in what had become a very large Learned Society; the need to enlarge, but manage effectively, the Society's staff; and the need for a new sense of direction in the fast changing postwar world. The intent was also to bring together representatives of the various constituencies within the Society, and to help prepare for the ASME's Centennial in ten years' time. The conferees understood the increasing concerns expressed by the public generally with regard to the application of technology. They also understood that the role of the engineer should include taking positions on public issues involving engineering. To sum up this Conference, the following paragraph from Sinclair should suffice:

> Inevitably....the conference was dominated by the Society's most well-known figures. Half of those attending were or soon would be members of Council. Consequently, the group tended to be older rather than younger and almost entirely a gathering of white male engineers. Yet the spirit and conclusions of Arden House were far from conservative. As a result of the feeling that they had so often been outpaced by events during the 1960's, the conferees overwhelmingly argued that ASME had to be 'more activist, more dynamic, more outreaching.' They expressed that sentiment in the form of an 'Over-riding Goal,' a great central idea of just the kind Donald Marlowe, ASME President and Conference Chairman, had hoped would emerge from such concentrated discussion. This goal which

> encompassed all other goals meant to describe the Society's principal future objective in unmistakable terms: To move vigorously from what is now essentially a technical society to a truly professional society, sensitive to the engineer's responsibility to the public and dedicated to a leadership role in making technology a true servant of man.' (24)

Canada

The earliest attempts to establish learned Societies in engineering in Canada predated Confederation. One of these was the Canadian Institute, founded in 1849, and with which Sandford Fleming was associated. Another was the Association of Provincial Land Surveyors and Institute of Civil Engineers which was incorporated under the Laws of Upper Canada. Neither succeeded. The Association disappeared. The Institute broadened its appeal, and went on to become the Royal Canadian Institute. The first attempt in the post-Confederation years was made when a Bill regulating civil engineers was presented to the Ontario Legislature in 1881, but it lacked the necessary support and never became law.

Engineering in Canada in the second half of the 19th Century was predominantly of the civil kind and much concerned with the construction of canals, railroads, bridges and municipal works, and with surveying. The railroads, in particular, helped encourage mining and mechanical engineering and the beginnings of manufacturing and industrialization. Electrical engineering developments came towards the end of the century, principally in the form of power and transportation projects. Most of the Canadian engineers of this period had learned their profession as pupils and many had connections with the United Kingdom or the United States. Some belonged to the Learned Societies already in existence in these two countries.

Fleming was not the 'founding father' of the Canadian Society of Civil Engineers. This title might more appropriately be given to the Irish-Canadian, E.W. Plunkett, or to the Scots-Canadian, Alan MacDougall. Both took steps - Plunkett in 1880 and MacDougall six years later - to seek the support of their colleagues. MacDougall was successful, and a series of meetings were held in Montreal, Ottawa and Toronto in 1886. He chaired the meeting on 4 March of that year in Montreal at which it was resolved:

> That a Society of engineers in Canada be formed comprising all branches of engineers, and that a committee be appointed to meet the other committees of engineers from other cities, and then to arrange and form a preliminary constitution, which form of constitution shall be sent around to those gentlemen who send their names as being willing to form such a Society....(25)

A local committee was immediately formed in Montreal and began the business of drafting the Constitution. This was then discussed and amended at a meeting of the local committee held in Ottawa later the same month. The local committee in Toronto appointed delegates to confer with those from Montreal and Ottawa. A provisional committee, which included representatives from the three cities,

was formed in November 1886 to complete the Constitution and to arrange for the Society to be established. It held a meeting for this purpose in Montreal on 9 December 1886 at which it was decided to name the proposed Society the 'Canadian Society of Civil Engineers.' It was also decided to hold a further meeting on 19 January 1887 for the election of members, and 162 of them were duly elected on that date. 126 more were added to the membership by the time of the First General Meeting on 24 February 1887 at the Harbour Commissioners' Building in Montreal, and at which the results of the ballot for the election of officers was announced. It was also decided to apply to the Dominion Government for a Charter. Walter Shanly, M.P., a founding Vice-President of the new Society and one of two well-known engineer brothers, piloted the Charter through Parliament. It received Royal Assent on 23 June 1887. The objects of the Society as set out in the Act were:

> ...to facilitate the acquirement and interchange of professional knowledge among its members, and more particularly to promote the acquisition of that species of knowledge which has special reference to the profession of civil enginering, and further, to encourage investigation in connection with all branches and departments of knowledge connected with the profession. (26)

The By-Laws of the Society made it clear that the term 'civil' engineering referred to all types of engineering activity other than military.

The Transactions of the Society, whose publication began in the founding year, state that on 25 June 1887 it was resolved at the meeting summoned for that day, that the President should be T.C. Keefer, supported by Walter Shanly, C.S. Gzowski and John Kennedy as Vice-Presidents, and that they, with sixteen others (including MacDougall), would constitute the Council of the Society. One of the sixteen, Professor H.T. Bovey, became Secretary-Treasurer. The majority were then from the three cities of Montreal, Toronto and Ottawa, but four were from Brockville, Winnipeg, Saint John and Stellarton. In addition to T.C. Keefer, ten other members of this first Council became Presidents of the Society. MacDougall was not one of them. He died in 1897. (27)

The first Headquarters of the Society were at McGill University in Montreal, where Secretary Bovey was Professor of Civil Engineering and Applied Mechanics and the first Dean of the Faculty of Applied Science. In 1890 the Society's office and library were moved to a building at the corner of Mansfield and St. Catherine Streets. Professor C.H. McLeod, also of McGill, replaced Henry Bovey as Secretary in 1891 and served in this capacity on a part-time basis for 25 years.

Unlike the ASME, which wrestled for decades with the problems of Local Sections, the Canadian Society moved somewhat faster. The first Branch was formed in Toronto in 1890, the second in Cape Breton in 1905 (although it became inactive several years later and was reactivated in 1921), and another seven before the beginning of World War I.

The CSCE did not have the 'Learned' engineering field to itself. The Canadian Institute of Mining, for example, was founded in 1898 and had both engineer and

non-engineer members. Some years later it added Metallurgy to its purview. Also in 1898 the Dominion Institute of Amalgamated Engineering was formed, again with both professional and non-professional members, but it remained active for only a few years.

There were those in the CSCE who believed that the Society, in addition to its 'Learned' role, should play another in helping the public distinguish between professional and non-profesional engineers. As early as 1896 a Committee chaired by Alan MacDougall was appointed to consider what might be done in this regard. As the Engineering Journal has reported:

> In consultation with provincial sub-committees, a draft Act of provincial incorporation was prepared, which, with some modifications, became law in Manitoba in 1896 and in Quebec in 1898, limiting the practice of 'civil' engineering to the members of the Society. These enactments, however, did not prove satisfactory in operation, and further provincial legislation was not attempted at that time. (28)

The Society's membership doubled in its first ten years, to around 600. By 1899 the availability of space at Headquarters in Montreal had become a problem and a move was made to a house at 877 Dorchester which had been bought and adapted. In 1913 the Headquarters moved again - to 2050 Mansfield Street - where the property had been purchased and enlarged. By 1914 and the beginning of World War I, the Society's membership had climbed to 3,000, and it remained around this level until the end of hostilities. 950 members served overseas during the War, and 119 were killed in action or died of injuries received on active service. In 1916, when Professor McLeod retired as Secretary, the Council decided that the duties of this officer had become sufficiently onerous and appointed his successor, Fraser S. Keith, to the position on a full-time basis.

In 1917 a report from the Committee on Society Affairs, chaired by Professor Haultain, was tabled. It recommended the change that affected Fraser Keith's appointment, mentioned above, and the establishment of a monthly journal - which was begun in 1918 when the Engineering Journal first appeared. It also recommended a change in the Society's name. This was done when the 1887 Act was amended in April 1918 and the Society became the Engineering Institute of Canada. Changes were also made to its organization and By-Laws, including the formation of provincial Divisions. At the First Professional Meeting of the new Institute in Toronto, President H.H. Vaughan said that one of the motives behind the changes in name and organization was the desire 'to unite all engineers in Canada in one Society, no matter to which branch of the profession they might belong.' (29)

In August of the same year, at the Second Professsional Meeting in Saskatoon, the question of professional status was discussed in a paper by F.H. Peters. Expressions of opinion at that meeting favoured action by the Institute to promote uniformity in any provincial legislation affecting this status, the provinces having jurisdiction over professions in Canada. At the Annual General Meeting in Ottawa in February 1919 a Committee chaired by C.E.W. Dodwell was struck to draw up a Model Law for possible provincial enactment. This was done quickly. Its proposals were approved in a subsequent ballot of the membership in

July 1919 and endorsed by the Council. The Model Law was then passed to the provincial Divisions and Branches for suitable action. The passage of the provincial Acts began in 1920 (and continued until all ten Provinces and the two Territories had formed Associations or the equivalent).

Meanwhile, in 1923, the new Institute's membership rose past 5,000 and more Branches were formed. The Engineering Journal was a success. A Committee on Policy chaired by J.B. Challies was appointed in 1920 and reported in 1923, with little new to recommend. In 1925, R.J. Durley replaced Fraser Keith as Secretary. In 1927 the first step was taken to provide for Branch participation in Institute policy when their representatives attended what was called the First Plenary Meeting of Council. With the exception of the Depression, these Plenary Meetings were held regularly for many years.

But around this time there began a debate involving the respective roles and relationships of the voluntary national Learned Societies, on the one hand, and the compulsory provincial professional registration Associations, on the other. These roles and relationships were - in practice - not clearly defined in the Model Law. Two of the main points of contention were admission standards and the billing of fees twice to those who belonged to both. It had also become clear that there were advantages to be had as a result of the legal status available through the Associations which did not apply to those who remained members of the Institute only. So in February 1926 the EIC Council and delegates from the (then seven, later eight) Provincial Associations met to discuss the possibilities for cooperation. The results were general, and the mood cordial. Following discussion at the First Plenary Meeting of the Council in 1927, a Committee was formed to discuss the problems involved in the coordination of Institute and Association activities, and it continued to function until 1931. The Institute representatives then stood aside to allow their Association colleagues to develop a common position. However, discussion within the Institute continued through the Committee on Development and, as a result of the failure of proposed revisions to the Institute's Charter and By-laws in 1934 and the debate at its Annual General Meeting in February 1935, a Committee on Consolidation was formed under the chairmanship of Gordon M. Pitts to examine how the Institute and the Associations could be joined into a single organization. This Committee deliberated for two years and produced further proposals for the amendment of the By-Laws, which again did not survive a membership vote. A proposal that would allow the Institute to enter into agreements with individual Associations was subsequently approved, however.

In addition to the Committees formed to discuss policy matters, the EIC established others to examine subjects of technical, public and business interest, including the deterioration of concrete in alkali soil, standard construction forms, the unemployment problem, and low cost housing. It also set up a free-to-members Employment Service Bureau to maintain a file on the qualifications and experience of those who registered with it. Membership numbers dropped during the Depression, as did revenues. The Council established a Non-Active List for those members unemployed which, at one time, included 700 names. Some Branches also took steps to help members in need. The Institute and the country began to pull out of the Depression in 1937. This was also the year that R.J. Durley retired as General Secretary of the institute and was succeeded by L. Austin Wright.

In 1938 the Engineering Institute - at the request of the Department of National Defence - collaborated with the Institute of Mining and Metallurgy and the Institute of Chemistry in the preparation of a register of technically trained men which could be used during the War whose coming seemed inevitable. When it actually came, the Institute gained strength rather than losing it. As during World War I, fees to members serving overseas were remitted. Paper shortages, however, affected the publication of the Engineering Journal. General Institute activity was curtailed until 1944 when some of those on active service began to return to civilian life.

The Institute prospered greatly in many ways in the first twenty years after World War II. In 1945, membership was 7,000. By 1948, it had reached 10,000, and climbed further to 20,000 by 1959. It peaked at around 22,000 in the early 1960's.

In 1949 the advertising revenue of the Journal met the full costs of publication, but this situation - unfortunately - did not last long. Many new Branches were formed in all of the regions of the country. For example, the 50th one was formed at Chalk River, Ontario, in 1958, and another ten by 1964. The Presidents and the General Secretary now had exhausting schedules of travel to meetings and to visit the Branches, in addition to whatever other commitments they had. Regional technical meetings were held regularly and were well attended, and Student activities were actively encouraged, including participation in the Annual Meetings of the Institute. Professional development courses were organized by the Branches.

In 1957 Austin Wright, who had served for 20 years, retired as General Secretary and was replaced by Garnet T. Page, who had been General Secretary of the Chemical Institute of Canada. In 1966 Page left for a career in the federal public service and Pierre Bournival took his place, serving out the period covered by this paper.

In the United States, the twenty years immediately after the end of World War II saw the establishment of a number of small, specialized 'Learned' Societies. The same was the case in Canada, where they included the Canadian Society for Agricultural Engineering, the Canadian Medical and Biological Engineering Society, the Canadian Society for Chemical Engineering, and the Canadian Aeronautics Institute (now the Aeronautics and Space Institute) whose founding owes something to the EIC.

The EIC, over the years, built up a solid record of participation and cooperation with foreign and international Learned Societies. For example, a formal agreement of cooperation with the ASME was first signed in 1943 and revised as required at intervals thereafter. The meetings of the ASME-EIC International Committee took place regularly. There were also meetings with Canadian representatives of the IMechE. However, the Institute was not in favour of the establishment by the IMechE of a Branch in Canada. As noted above, the Institute was the Canadian member of the (US) Engineers' Council for Professional Development. It participated in meetings of the Commonwealth Engineers' Council, the Joint Engineering Management Conference, the World Federation of Engineering Societies and the Pan-American Council of Engineering Institutions (UPADI), some of which were held in Canada.

As George M. Dick wrote in a Presidential report in 1960:

> No organization can remain stationary for very long. It must either be rising or falling. Those leading the Institute this year have felt that we must put special emphasis on pushing it into broader and more effective fields. More members, more Branches, more technical activities, more publicity - all are necessary to help us on our upward path. New and active Committees of Council are implementing our targets. We are facing changing conditions on many of our engineering fronts.
>
> We must analyse these transitions and be prepared to meet them. We must render to our members, under all possible methods of operation, whatever they need to make them more capable than ever of raising the standard of technological activity in Canada. We must encourage our engineers, technicians and scientists to do their share in the pressing need for accelerated development of Canada's natural resources with which the growth of Canada's economy is so directly integrated. (30)

A second serious attempt to 'confederate' the engineering profession in Canada began in 1957 when the Institute and the Canadian Council of Professional Engineers (representing the Provincial Associations and the Corporation in Quebec) formed Committees to study this problem. This activity continued for six years, but again ended in failure. A third attempt was made with less fanfare and involvement in the late 1960's but, by this time, it no longer generated the same priority or enthusiasm.

During its lifetime, the Engineering Institute has celebrated a number of Anniversaries. One such was the 1937 Golden Jubilee of the founding of the Canadian Society of Civil Engineers. Another was the 25th Anniversary of the starting of the Engineering Journal in 1943. Yet another was the (lower key) celebration of the 75th Anniversary of the 1887 founding of the Civil Engineering Society. Then there was the celebration of Canada's Centennial in 1967, when a special Engineering Congress was held in Montreal in which a dozen Learned and other engineering Societies participated. The 50th Anniversary of the first issue of the Journal was in 1968.

In 1965 the building on the site at 2050 Mansfield which had served as the CSCE and EIC Headquarters for 52 years was demolished and a high-rise replacement built. Two years later the Institute moved into two floors of this new building.

Also in 1967, a Special Committee formed by the EIC presented to the Federal Government a report on Engineering Research in Canada, and shortly thereafter the Institute submitted a brief on the same subject to the Senate Special Committee on Science Policy.

One of the most important organizational changes made by the EIC Council in the late 1950's was the replacement of the long-standing Papers Committee with the Committee on Technical Operations (CTO). This new Committee had a greatly increased mandate. In addition to encouraging the writing and presentation of papers to the Annual and other Meetings, it took an active part in encouraging

the formation of Technical Divisions (with their own Executive Committees) within the Institute for the development of the individual engineering disciplines and sub-disciplines. For example, the original list included civil, mechanical, electrical, chemical, mining, and hydro-electric engineering. As time went on, more were added.

In 1968, in the spirit of President Dick's words of eight years earlier and in pursuit of its desire to become more effective in assisting the interchange of technical information, the Institute Council accepted the recommendation of the CTO that it should support and encourage its Technical Divisions to become autonomous Constituent Societies operating within the EIC Charter. This step also recognized the emergence of many new sub-disciplines of engineering, some of which were leading to the founding of new Societies in Canada, as well as the recent or proposed establishment of Branches or Sections of foreign learned Societies in Canada - all of which the CTO called 'Splinter Societies.' The Council, which had at one time believed it could accommodate Splinter Society interests within its existing structure, now felt that Constituent Societies based on the major disciplines of engineering could provide for these interests more effectively.

In June the CTO approved the setting up of a Steering Committee - to be chaired by Mr Clifford N. Downing - to develop a proposal for the establishment of an EIC Constituent Society in mechanical engineering. It was to operate as a Sub-Committee of the Mechanical Engineering Division of the CTO and its membership would include the Chairman of that Division and the Chairmen of the other mechanically-oriented CTO Divisions, plus representatives of the EIC, ASME and IMechE and the General Manager of the EIC, who would also provide staff support. Additional appointments to the Downing Committee were made during its lifetime. The IMechE, which was proposing to establish a Canadian Branch, agreed postpone this step to allow the Committee to do its work.

The Downing Committee met for the first time in early August 1968. It met again on 8 October to consider drafts of a Constitution and By-Laws, membership grades and qualifications, and other matters. The report of this meeting made to the CTO on 11 November included the following unanimously-agreed statements:

> - there is a need to establish a Canadian Mechanical Engineering Society, with the preferred name of the Canadian Society of Mechanical Engineers; it will be a Constituent Society of the Engineering Institute of Canada, and will be self-governing within the framework and Charter of the Institute;
>
> - the membership objective of the Society would be all qualified mechanical engineers in Canada; but while this membership shall consist primarily of mechanical engineers, it shall be open to persons qualified in associated disciplines, as established by the By-Laws; and corporate members of the Society will also be members of the Institute;
>
> - the Society should eliminate the need for the existence of Branches or Sections of foreign-based mechanical engineering Societies in Canada; it should, instead, represent the foreign-based

> Societies in Canada and provide a channel for the distribution and disseminating of their technical publications etc.; and the Canadian Society should enter into agreements with the foreign-based Societies, such that a member of the CSME who is also a member of such a Society could retain the latter membership at a reduced fee based on his limited ability to utilize the benefits of that membership. (31)

Shortly thereafter the EIC set up a Committee to study amendments to its own By-Laws to ensure that Constituent Societies, as they were formed, would be adequately represented in the government of the Institute.

The Chairman of the Mechanical Engineering Division of the CTO reported to that Committee at the end of January 1969 that the Secretary of the IMechE had written to Institution members in Canada saying that the Institution Council welcomed the proposal to found the CSME and had agreed to a joint press release in regard to it. The CTO also heard that the ASME Council had agreed in principle with the concept of the CSME and that a press release to this effect would be issued. The Committee heard that the EIC Council had approved a report on the work of the Downing Committee and had recommended that the CSME be brought into being as soon as possible.

But several further meetings of the two Committees and the Council were needed before this could happen. One problem was the reconciliation and approval of the Constitution and By-Laws of the CSME and the changes to the EIC By-Laws by the Institute's Council, and another was the potential effects of the formation of Constituent Societies on the Institute's existing regional structure. As well, the UK Institution of Production Engineers, which then had around 150 members in Canada, expressed an interest in forming an EIC Constituent Society rather than becoming a Division of the CSME. The initial deadline for the formation of the CSME - November 1969 - came and went with the work of founding uncompleted.

At its meeting on 18 January 1970 the CTO approved in principle the proposed Constitution and By-Laws of the Canadian Society <u>for</u> Mechanical Engineering and recommended approval to the Institute Council. This was given on 31 January. The small change in the name, from the original suggestion, reflected one of the stated objectives of the new Society - namely - that it wished to draw its membership from a constituency broader than just those who had qualified professionally as mechanical engineers.

The first meeting of the National Executive of the new Society was held on 7 March and its principal officers were elected. Dr Hugh G. Conn of Queen's University, Kingston, became the Founding President. As promised, the announcement of the founding of CSME was endorsed by the ASME and the IMechE and was made simultaneously in the three countries on 11 April 1970, which then became the Society's Anniversary date. Its chief objectives were to facilitate the acquisition of professional knowledge by its members, to provide for continuing education within the profession, to contribute to the developemnt of higher standards of mechanical engineering in Canada, and to enhance the contribution of mechanical engineers to the Canadian economy.

The CSME President subsequently took his seat on the Institute's Council, as did

its representative on the CTO. The Society moved quickly to establish three Specialist Divisions, each with its own Executive. These were: Mechanics and Applied Mechanics; Heat Transfer and Thermodynamics; and Production Engineering, which had the support of the UK IProdE. It also began right away to organize activities at the Regional, Section and Student Section levels. While continuing to make use of the monthly Engineering Journal published by the Institute for announcements of activities and the publication of some papers and articles, it also established a Publications Committee which it made responsible for the publication of the CSME Transactions. CSME took over responsibility for cooperation with ASME and IMechE from the Institute, and it organized its first technical sessions at the EIC Annual Meeting in September 1970. A vigorous membership campaign was launched. Analysis of the initial membership showed that the dominant group within the new Society belonged to the industry sector.

New Zealand

Surprisingly, perhaps, a national Learned Society for engineering was formed in New Zealand before the corresponding one in Australia.

It happened in 1914, when the country had a population of just over one million, and when a number of actual and potential economic-cum-technical situations had drawn attention to the growing maturity of engineering there. For example, the development of refrigeration was beginning to play a major role in the development of the economy, as was wool which increasingly made use of electro-mechanical means for shearing. The completion of the Panama Canal was opening up the British markets to New Zealand's products. The majority of domestic public money was being spent on railways, roads and buildings designed and built by New Zealand engineers. There was, however, very little manufacturing, but this grew in the years of World War I and afterwards. The steam traction engine was practically the only source of mechanical power. Hydro power was still in its infancy, although the installation of electric light in the cities had begun. The daily newspaper was the principal means of mass communication. Often, for the New Zealand engineer in 1914, the only source of information about engineering developments abroad was the technical and occasional report. The vast majority of engineers at this time were civils. For the few mechanicals, employment was usually in the refrigeration business, in workshops involved with agricultural machinery or locomotives, or in contracting. Newnham has noted:

> It is difficult for one who was a young man in 1914 to give a correct assessment of the state of engineering practice at that time....Besides, in 1914, the young engineer had very little opportunity of meeting other engineers, particularly older engineers, and his work, his conduct and his ideas of engineering practice and procedures were largely derived from, and influenced by, his contact with his immediate superior. Many a younger (civil) engineer of that period spent much of his time in an isolated survey or construction camp, more-or-less completely out of touch with the refinements of living and opportunities for the proper study of the fundamentals of his chosen profession. His technical library most likely consisted on Molesworth's pocketbook, Chambers logarithms and, if he were really determined to study the fundamentals of

> engineering science and to pass his examinations, a few textbooks covering the necessary subjects. (32)

Although Canterbury College had established a School of Engineering in 1888 and was producing a few graduates each year, these graduates found few jobs in New Zealand even although employers of engineers recognized that the fundamentals of engineering science could only be learned in College. The 'hard way' was, for most, the only way to become an engineer. The result was that the young New Zealand engineer of the pre-World War I period most likely had, as his academic objective, passing the examinations of the Institutions of Civil, Electrical or Mechanical Engineers in the UK rather than a College degree. He was also, most likely, a pupil, cadet or indentured apprentice. Most of the senior engineers belonged to the 'parent' Institutions in London.

In 1911, a group of municipal and local body (government) engineers became alarmed that the New Zealand Institute of Surveyors wished to make it a condition of employment that all such engineers should be registered surveyors. One of the senior members of the group took the initiative and, as a result, a meeting was held in Wellington on 20 March 1912 at which it was decided to form an Institute of Local Government Engineers of New Zealand for 'the promotion of engineering knowledge and practice in connection with local government work, and of the professional interests of members.' This Institute remained in existence for only two years, during which time its membership increased from 25 to over 100. (33)

Towards the end of 1913, the Chairman of the Institution of Civil Engineers' Advisory Committee in New Zealand called his members together to discuss the possibility of forming a Society of Civil Engineers - with close ties to London - on the grounds that it would be more representative of engineers in the country than the Local Government Institute. William Ferguson attended this meeting, but felt that a Society that included the New Zealand members of the Civil Institution in London and a few electrical and mechanical engineers 'would not represent the engineering talent of the Dominion.' He put forward the view that the Society proposal ought to be discussed with the Local Government people. As well, he took the view that 'a strong Society, thoroughly representative of all branches of the profession, might be formed, and that this would have more weight and be more satisfactory than two or more Societies.' (34)

Ferguson - a member of both the Civil and Mechanical Institutions in London - was asked to pursue the matter along the lines he had suggested. As a result, and after much discussion at its Second Annual Meeting in March 1914, the Institute of Local Government Engineers agreed to wind up its activities and transfer its assets on the incorporation (under the Incorporated Societies Act) of the New Zealand Society of Civil Engineers. This happened in June. So in a sense there were 100-or so 'founding fathers' in the case of the NZSCE, although, if one were to be singled out, his name would be Ferguson.

The objects of the new Society included the following:

> - to define the various qualifications and the status of professional engineers; to obtain public recognition of the necessary qualifications in persons who are to be entrusted with the design and execution of engineering works, and particularly for the

> efficient and economical expenditure of public funds on such works; to seek to obtain legal recognition of such qualifications;
>
> - with respect to local bodies, and generally, to ensure the employment of qualified engineers, to obtain the maximum benefit from the expenditure of public funds, and to ensure proper recognition of professional status;
>
> - to expose persons making false representations as to their engineering qualifications, and to take such steps as may be deemed advisable by the Council to secure their punishment;
>
> - to provide for the education and examination of engineering students; to bring about more general professional intercourse, and exchange of ideas and experiences amongst engineers in New Zealand; to cooperate with various allied institutions in Great Britain and elsewhere in the furtherance of their common objects; generally to promote the advancement of mechanical science and the acquisition of engineering knowledge. (35)

These objects went some way towards meeting Ferguson's priorities for the new Society.

The founding membership of the NZSCE in 1914 was an even 100, and 45 of them attended the first Annual General Meeting of the Society held in Dunedin in March 1915. Many of the Executive of the Local Government Institute served on the first Council of the new Institute. William Ferguson was named Honorary Secretary, with R.S. Rounthwaite as Secretary. It was recognized early that the new Society should have local Branches in order that its development should proceed, and steps were taken in this regard. As would be expected, the first stages of this development were influenced by the distractions of World War I and its immediate aftermath. However, by 1924 the Society's membership had increased to almost 400, ten successful Annual Meetings had been held, and there were Branches at Canterbury, Taranaki, North Wellington and Auckland. NZSCE was accepted as the representative body of the civil branch of the profession - but not yet of the whole profession - and its Proceedings as a source of professional information. William Ferguson had served as President for the year 1919-1920.

The question of introducing registration as the means for fixing the standards of qualification of engineers was of concern at the Dunedin meeting of the New Zealand Society in 1924. The Society itself had, of course, laid down the qualifications required for membership, but these had no force in law. It was thought that registration might well provide this. The first Council of the Society had drafted a Bill and a motion affirming its principles was passed at Dunedin in 1915. The Council was asked to promote it. But opposition developed, especially from those who feared for their jobs. The Council then tried to reconcile the conflicting views. In 1920 a further attempt was made to persuade the Minister of Public Works to draft a new Bill and have the Cabinet support it, but again the Society was not successful. Further attempts were then made to satisfy opponents and these were sufficiently successsful. Towards the end of the 1924 Session of Parliament, an Act - whose reception was on the whole very favourable - was placed on the Statute Book. The first members of the

Registration Board established under this Act took office in March 1925. The Act required that the three members appointed on the recommendation of the Council of the Society had to be representative of civil, electrical and mechanical engineers. The Board required that its members had to be registered engineers. The Registrar was required by the Act to be a civil servant and by the Board to be a registered engineer. W.L. Newnham himself was the first to hold this office. (36)

For many years the position of engineers employed by local authorities had not been satisfactory. In 1928 the Council of the NZSCE made strong representations to the Government which resulted in amendments to the Municipal Corporations Act and improvements in the situation.

The Depression that hit North America in 1929 took another two years to reach New Zealand, after which employment opportunities for engineers became very scarce. The Government's engineering operations were effectively shut down. However, the Society took no special part in the attempts to solve the consequent employment and other problems. New graduates were in a specially difficult position since cadets were taking the majority of the junior jobs which they normally did.

R.S. Rounthwaite retired as the Society's Secretary in 1930 and was replaced by H.L. Cole, who was a mechanical engineer.

In 1932 an organization was set up to promote standards and standardization in New Zealand. The NZSCE agreed that this Standards Institution could have its Headquarters at the Society's office, as a paying tenant. H.L. Cole worked closely with the Institution and it made a good start with its work. However, it took another thirty years for the New Zealand Standards Act to become law.

In 1933 the Society began publication of a half-yearly Bulletin, which became quarterly in 1934. Eventually, its content was taken over by New Zealand Engineering.

By the late 1920's there was growing dissatisfaction with the name of the Society, and especially among the younger mechanical and electrical engineers. This issue was debated at the 1928 Annual Conference. A referendum was held, but the majority favoured no change. The issue surfaced again in 1936 and was discussed at the 1937 Conference. This time a change was favoured and the subsequent referendum approved that the Society be renamed the New Zealand Institution of Engineers. Approval was formally given in September 1937 and the change became effective immediately.

In 1940 the Institution held a special Congress in Wellington as part of New Zealand's Centennial celebrations. Its membership had reached 600 around this time, and almost half of all of the members attended the Congress.

During World War II, and especially after Japan entered it, the main engineering activities in New Zealand were war-related. The Institution's activities fell to low levels. The Annual Conference attendances were badly affected.

However, during 1943 an important event in professional engineering took place. Again its cause was dissatisfaction among the younger members with the position

of the NZIE Council on economic welfare matters that particularly affected them. A report was issued, and the Council's attitude bordered on hostile. On 31 August 1943, a group of members in Wellington resolved to establish a welfare society, to be called the Professional Engineers Association of New Zealand. A provisional Council was chosen and asked to draw up a constitution and begin enrolling members. This proved to be an onerous task and its completion was delayed. However, by the end of 1944 the PEA had 500 members, a positive bank balance, and almost a Constitution. It even had a monthly journal, The Professional Engineer, which accepted advertising to help pay for the cost of publication. It was also successful. The members of the NZIE eventually agreed there was a need for an organization such as the PEA.

H.L. Cole resigned as Secretary of the Institution in 1944 and was succeeded by D.L. Bedingfield, who was a lawyer and accountant. The first Student Chapter of the NZIE was formed at Canterbury University College in 1945, and the second one at the University of Auckland in 1949. Representatives of the New Zealand Institution of Engineers attended the first meeting of the Commonwealth Engineers' Council in London, England, in 1946, and subsequent ones at four year intervals.

In 1949 the Consultative Committee on Professional Engineering Education presented a report to the Government which said that a full-time University course was essential for the proper education of professional engineers. Not all members of the Institution agreed with this point of view, and a long and often heated debate began.

The Institution made its first attempt to obtain a Royal Charter in 1951, and it was not successful. By the end of the period covered in this paper, a second attempt had not been made. In 1951, also, the last issue of the annual Proceedings appeared, and since then New Zealand Engineering has been the vehicle for Institution news, business, and other transactions.

In 1952, the NZIE participated with the Institution of Engineers, Australia, in a joint conference in Melbourne on Soil Mechanics (associated with the International Society for Soil Mechanics and Foundation Engineering). Subsequent conferences have been held in New Zealand and Australia.

Also in 1952, the Institution purchased property in Wellington for its Headquarters. The PEA and the Registration Board arranged with the NZIE to rent parts of it for their own HQ. This property was sold ten years later. By 1955 the Institution's membership exceeded 1,600 - double that of a decade earlier - two-thirds of whom were corporate members.

Also in 1955, the question of the continuation of the PEA as a separate entity from the NZIE was seriously raised, the main argument against it being that the Association and the Institution had a high degree of common membership. A questionnaire revealed a majority in favour of merging. However, another four years were to pass before this actually took place - on 23 June 1959 - and the Institution took over the Association's responsibilities and assets, including its monthly magazine, which was merged with New Zealand Engineering. The Constitution of the NZIE was amended to allow it to perform the type of duties the Association had performed. The PEA had achieved most of what it had set out

to do. On the other hand, as Newnham has noted, the PEA brought engineers together in a way technical papers had never quite succeeded in doing. (37)

The decade that began in 1955 saw great activity in the various Branches of the Institution - of which there were 16 by the mid-sixties - and especially those at Auckland and Wellington. Some 700 members and their spouses attended the Jubilee Conference of the Institution organized by the Wellington Branch in 1964. By the end of that year the membership stood at 2,900.

In 1962 a referendum was held to seek opinions on two proposals. The first was to add the word 'Professional' to the title of the Institute, and this one was defeated. The second was to change the designation of Institution 'Member' to 'Fellow', and 'Associate Member' to 'Member', with the Associate Member grade disappearing. This one was approved, and was later confirmed at an Annual Conference.

The first engineering degree from a New Zealand institution was given by the Christchurch School in 1896. In 1963, the degree-granting schools together produced 203 graduates, all of whom later got full professional qualifications. 10 more qualified by passing the NZIE exams, and 14 more by completing the exams of the senior UK Institutions.

In 1964 R.W.K. Stevens succeeded D.L. Bedingfield as Secretary of the NZIE. J.G. Porteous had become Deputy Secretary in 1960. A.J. Bartlett was appointed Assistant Secretary in 1968. In 1966 the Institution moved into new Headquareters on Molesworth Street in Wellington. In 1970 the Institution had 4,000 members, of whom 3,000 had corporate status.

Australia

Corbett has summed up the Australian situation in the years just before the establishment of the Institution of Engineers, Australia - or IEAust as it has become known - in this paragraph from his book:

> At the turn of the century when the six colonies decided to federate, 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. 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. Otherwise the environment was little changed. But in men's minds there was dissatisfaction with many facets of pre-war life, and engineers were moved to examine the absurdity of having one or more engineering societies in each of the States of the Commonwealth. (38)

But to step back in time for a moment, the Royal Society of New South Wales was founded in 1866 and, over the years that followed, enjoyed the support of engineers. In September 1870 James Laing distributed a pamphlet to mechanical engineers and members of the iron trades in Sydney advocating the formation of

a Society 'for the friendly interchange of opinions, ideas and knowledge.' (39) The outcome was the founding of the Engineering Association of New South Wales. The Victorian Institute of Engineers was established in Melbourne in 1883, the University of Melbourne Engineering Society in 1889, and the University of Sydney Engineering Society in 1895. The Mechanical Engineers' Association of Queensland was first founded in 1886 but was wound up for a while, re-emerging in 1911 after joining up with an Electrical Association. The Northern Engineering Institute of New South Wales was in operation at Newcastle from 1889 to 1894, and again from 1908 to 1919. In 1891 the Electric Club of New South Wales was founded, becoming the Electrical Association of that State in 1896. The Australasian Institute of Mining Engineers was founded at Broken Hill in 1893. In the other States, where engineers were not so numerous, Institutions were not formed until after 1900. For example, the one in Western Australia dates from 1910. Many leading engineers, however, preferred to belong to the appropriate UK Institution in London.

In 1912 the Victorian Institute indicated its willingness to federate with any other similar Society in Australia or New Zealand. In 1914 the Electrical Associations of Victoria and New South Wales agreed to federate, with the possibility of bringing other Societies into a relationship with them. In 1917, during World War I, the South Australian Institute of Engineers sent a letter to other kindred Societies urging immediate action to form an Australian Institute of Engineers. The Association in New South Wales was receptive and decided to take action. Soon after, the five societies then in existence in New South Wales held a meeting in Sydney to discuss the possibilities for federation at which D.F.J. Harricks was a leading participant. In February 1918, Harricks convened a conference of invited and interested Societies in Melbourne. This particular conference decided on a form of Institution that combined federation with amalgamation. The membership problem was solved by the use of the 'grandfathering' technique. All under the age of 25 would be classed as Students or Graduates, all over 25 as Associate Members, and those AM's over 33 could apply to become Full Members. It was also resolved that federal control in the new Australian Institution would be restricted to federal matters and that the existing Institutions would preserve their separate identities as far as possible. A Provisional Council was appointed. It met in Sydney on 15 and 16 May 1918, and every engineering Institution in the Commonwealth was represented. Harricks was elected Chairman of the Council and he initiated a discussion of an appropriate Constitution for the new Institution. A Committee was appointed to produce drafts of this, and a final draft was sent to each of the participating Institutions along with an invitation to become a Foundation Society by 1 August 1919. By this date, twelve Institutions had accepted the Constitution and had decided to join. The three that voted against joining were the Australasian Institute of Mining and Metallurgy, the Victorian Institute of Engineers, and the Institute of Local Government Engineers.

So the Institution of Engineers, Australia, was 'born' in a different way from the others considered in this paper. Its 'founding father' was Harricks, who declined nomination as the founding President but offered his services as Honorary Secretary until a salaried officer could be appointed. He was elected to the first Council and served as a member of it until his retirement in 1939, having taken the office of President in 1929.

The first President of IEAust (for 1920) was William Henry Warren, the occupant of the Challis Chair of Engineering at the University of Sydney where, in 1895, he had been elected the first President of the University Engineering Society. Born in England, Warren received his training there and in Ireland. He has been described as a Civil Engineer, but his background included an apprenticeship at the London and North-Western Railway Locomotive Works at Wolverton in Buckinghamshire. He was elected to lead the IEAust at the first Council meeting on 20 October 1919. In his book, Corbett mentions Warren's first presidential address, and goes on to say:

> In the same address Warren developed several...themes which are still important in the Institution. He suggested a Code of Ethics in six simple clauses, based on the code of the American Society of Civil Engineers. He suggested the registration of engineers with the Institution as their qualifying body, coupled with restrictions on the use of the word engineer. He set out his ideas on the education and training of engineers, and said he was satisfied with the University of Sydney courses which were more like those of the United States than those of Great Britain. Finally, he urged every engineer to pay his debt to his profession....(40)

The first Institution Headquarters were located in Sydney, at the Royal Society's House on Elizabeth Street, since the majority of the membership lived and worked there (666 corporate Members, versus 309 in Melbourne), and since the oldest of the Foundation Societies was the Engineering Association of NSW. The office and library of this Association were transferred to the IEAust and were shared by the Headquarters and the Sydney Division of the Institution.

The Foundation Societies and their members had become Divisions of the new Institution. As Corbett has noted:

> Divisions were permitted by the first Constitution to make their own rules, but the difficulty of coordinating 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 organizations with a federal structure, and the authority of the Council has been established by precedent in ever widening fields. (41)

The Founding Societies - in practice and over the years - gradually disappeared leaving the Divisions, each governed by its own Committee, as geographical units of the Institution. But sub-division on a technical basis into Groups was also found to be possible, and the retention of the specific technical identities of the Founding Societies was brought about through the formation of Branch of the Divisions, as was the case when the Local Government Branch of the Sydney Division was set up in 1921. Junior and Student Sections were encouraged from the beginning. In the early days of the IEAust, the Divisions were a vital part of the overall organization since Australia - like Canada - was subject to the 'tyranny' of distance. Travel was time-consuming and only small numbers of national conferences could be arranged profitably.

In 1920 the Council thought that the awarding of a Royal Charter might help in the process of unifying the Divisions within the Institution, but its members were persuaded that such a Charter would not then be granted. It was not until 1935 that this question was seriously approached and a petition addressed to His Majesty the King. When it was eventually granted, the Charter bore the date 10 March 1938. But this was not the end of the road. A number of legal and housekeping chores remained, including the compiling of a new set of By-Laws. The work was finally finished in May 1941. One of the effects of the Charter was that Corporate Members could be addressed with the title of Chartered Engineer (Australia).

The first Council of IEAust found it expedient to appoint an Executive Committee, and there has been one ever since. From the beginning, also, the Council made it a policy to hold the Annual Conferences in the different States, which enabled the Council to hold its own meetings around the country and not just in Sydney. But the dificulties of travel in the early years of the Institution often made it hard for the Council to find members for all of its Standing Committees. As Corbett has noted:

> In 1925 Council reported that Headquarters Committees would have a membership restricted to Councillors resident in Sydney and Newcastle, while minutes were sent to General Committees which included divisional members, presumably in other States. Only in recent years (post WW II) have Divisions other than Sydney been invited to contribute a substantial membership to the Standing Committees. The coordination of activities in a federated Institution between local Divisions and the federal governing body raises many controversial issues. In 1929 a proposal was submitted to members that Chairmen of Divisions should be automatically members of Council, but this was rejected. However, a Standing Committee of Division Chairmen was constituted, and Chairmen were given the privilege of attending Council meetings without voting rights. This issue was raised again in 1950 and in 1957, but the policy adopted in 1929 has remained (as of 1969). (42)

One of the early Presidents of the IEAust - in 1935 - was Henry Barraclough, who had graduated in engineering from the University of Sydney in 1892. He did graduate work at Sibley College of Engineering at Cornell University where he came under the influence of Robert H. Thurston, the first President of ASME. Barraclough returned to Australia in 1897 to become Assistant Lecturer in Mechanical Engineering at Sydney. He became the first Professor of Mechanical Engineering at that University, and was later knighted.

The IEAust, between its founding and the end of the period covered by this paper, had only three Secretaries. The first - Harricks - served as he said he would only until a full-time officer could be appointed. He was E.S. Maclean, who was appointed in 1921 and died 'in harness' aboard ship on his way to the first Commonwealth Engineering Conference in London in 1946. C.H.D. Harper was appointed to replace Maclean in January 1947, and was still serving in 1970. In 1967, and Assistant Secretary (Technical) - H.G. Bayley - was appointed to ease the growing load on Harper, and in 1969 E.D. Storr was appointed Deputy Secretary (and succeeded to the Secretary's position in 1972).

As noted above, the Institution's first 'home' in Sydney was on Elizabeth Street. In 1924 the Headquarters and Sydney Division moved to Macleay House on College Street, Sydney, and in 1931 to Science House on Gloucester Street. In 1967 the Sydney Division moved to North Sydney, releasing badly needed space for the growing Headquarters activities. In 1963 the possibility of moving the Headquarters to a yet-to-be-built, Institution-owned building in the National Capital in Canberra was raised. But it was only after much discusssion and ups and downs - with not everyone agreeing that such a move made sense - that the move was finally made. The Governor General of Australia, Sir Paul Hasluck, set in place a stone commemorating both the move of the Headquarters to Canberra and the Golden Jubilee of the Institution on 31 July 1969.

The IEAust maintained (in 1969) its position as the accreditation authority for engineering qualifications in Australia. To help do this, the Council set up two Standing Committees - one, the Board of Examiners concerned with engineering education, and the other the Qualifications for Membership Committee concerned with engineering practice. The background to their respective duties has been explained by Corbett:

> In 1919 examinations were comparatively novel in the United Kingdom Engineering Institutions, but Harricks and other founders of the Australian Institution were determined to establish the status of their profession by maintaining adequate entrance standards. The first Council set up an Examinations Committee, which later became known as the Board of Examiners, and as such has continued to the present as one of the most important committees of Council.
>
> This Committee proposed to hold the first examinations in 1921, but the initial difficulties resulted in deferment to March and November 1923. In the meantime the Committee had presented a first report to the Council outlining the general scheme of examinations and a second report included rules and regulations relating to examinations and recommendations for exempting qualifications. Thus the two major functions of the Board of Examiners were established in the second year of the life of the Institution.....
>
> The Membership Committee (in 1969) is concerned with applications for admission to the grades of Fellow and Member and for transfer to these grades. It is not concerned with academic qualifications which are handled by the Board of Examiners.....An application for admission or transfer is first dealt with by the Membership Sub-Committee of the Division to which the applicant is, or would be, attached...The Membership Committee is divided into two panels, Civil and non-Civil, each panel consisting of about six members knowledgeable in some section of the area covered....If all (panel) members are satisfied, the application is not considered at the meeting of the (full) Committee....(43)

The IEAust Council has had responsibility for the quality of the technical papers published by the Institution but delegated this to the Publications and Papers Committee, which functioned from the beginning in 1919. The Transactions were first published in annual volumes, and no advertising was accepted. The

publication of a Quarterly Bulletin began in January 1924 and carried advertising as well as the news and business of the Institution. Publication of the Bulletin ceased in 1929 when it was 'succeeded' by The Journal of the Institution which first appeared monthly in 1929 and incorporated the Transactions. The Journal suffered from paper shortages during World War II - as did the corresponding publications of other the Institutions covered in this paper.

In 1958 the suggestion was made that the IEAust should increase the number of its publications to cater for the specialized fields of engineering. The Council agreed that a three-publication 'stable' could be tried. All would carry advertising. There would be the Journal as before, the Civil Engineering Transactions and the Electrical and Mechanical Engineering Transactions. Members would automatically receive the Journal and the Transactions of their choice. After 1965, three series of Transactions were published - Civil as before, plus Mechanical and Chemical and Electrical. To maintain the link between mechanical and electrical engineers, members could receive the Journal and two of the Transactions series. The Institution's Library has had its own publications, and the Institution itself has published a variety of conference, technical and other reports and the occasional book, such as Corbett's.

Within the time period covered by this paper, the IEAust had made no arrangements to form a national group consisting solely of mechanical engineers. (This development had to wait for the 1970's.) However, the majority of the Divisions of the Institution formed Mechanical Engineering Branches in which special discussions etc. in this discipline could be pursued. But in 1963 a group of senior electrical engineers had drawn the Council's attention to the international activities of British and American Societies which were competing for the attention of engineers in Australia. As a result of this, an ad hoc Committee was set up to study the problem. In due course, the Council agreed to establish a national Electrical and Electronics Board as an experiment. But as Corbett has written:

> There was a hope that (this) Board might cooperate with and coordinate the activities of the Electrical Engineering Branches in Divisions. However,...the main activity of the Board has been the organization of technical conferences on an Australia-wide basis. The Board includes members appointed by the Council and two representatives nominated by each Division's Electrical Branch. Because of the number of interstate members and the high cost of travel and accommodation, the Board...can meet only twice a year. (44)

With regard to Divisions, in 1969 the Western Australia Division had Branches for Concrete, Electrical and Electronic Engineering, Hydrology, and Mechanical Engineering, a Graduates and Students Section, and a Soil Mechanics and Foundation Engineering (SM & FE) Group. The Canberra Division had no Branches. The Sydney Division had an SM & FE Group, a Graduates and Students Section, and Branches for Chemical Engineering, Civil Engineering, Electrical and Communications Engineering, Management and Industrial Engineering, and Mechanical Engineering.

In 1922 the Institution's membership reached 2,000. By 1946 it had risen to

5,500. Twenty years later there were around 17,000 members, and in 1970 around 22,000.

Finally, a few Comments...

These comments are brief and general, for three principal reasons:

- first, whole books have been written about the Societies whose founding and development have been described in a few pages in this paper, so that the stories in it are not complete;

- second, the descriptions end roughly at 1970 and no attempt has been made to 'translate' the Societies' development into terms that are fully relevant in the 1990's; and

- third, the subject matter covered is not exactly the same for all of the Societies.

The comments therefore serve as a kind of summary based on the information actually presented.

* The two largest national Societies (in 1970) are also the two oldest, are in the two most populous countries, and have been devoted exclusively to mechanical engineering since their founding - namely, the IMechE and the ASME.

* The other three national Societies are much smaller (in 1970), belong to three Commonwealth countries with much smaller populations than the UK (and the US), and include members from non-mechanical as well as mechanical disciplines. All three have remained multi-disciplinary. Even the Canadian Society of Civil Engineers at the time of its founding, and the EIC after 1918, welcomed all disciplines. And the EIC remained so in 1970 since the CSME and the Constituent Societies founded after it were established under the Institute's Charter. Initially, however, two of the three Societies - in Canada and New Zealand - were civil-discipline-dominated. The IEAust had a broader initial base, due in part to the time of its founding and in part to the fact that it began as a federation of regional specialist Societies. The EIC only became a federation after 1970.

* To greater or lesser degrees, the Societies in all five countries owed something to current developments in the engineering of transportation and transportation equipment at the time of their founding.

* Over the years, the main objectives of all five Societies have been similar and concerned principally with the transfer of engineering information through a variety of means, raising national standards of engineering practice and education, and encouraging research, development and innovation.

* In only one case - that of New Zealand - has the Headquarters of the Society always been located in the national capital. In the case of the UK, the IMechE moved there 30 years after it was founded and, for the IEAust, 50 years later. The ASME has always had its Headquarters in New York. The CSCE-EIC-CSME Headquarters during the period covered in this paper were located in Montreal.

* All five Societies have taken steps to accommodate the technical interests of their members, with varying degrees of success. The structures of all of the Societies have been modified as their respective memberships and the disciplines of engineering have developed, again with varying degrees of success. Four of the Societies had to adapt to special operating conditions during World War I, and all five during the Depression of the 1930's and World War II. However, for all of them, the first two decades after 1945 included periods of strong growth in membership and activity. They have also had to deal with 'Splinter Societies' at one time or another. And the Societies in the three largest countries have had to take into account their widely scattered memberships and the effects of transportation costs on the ability of members to participate in Society activities.

* The influence of the IMechE (and other UK Societies) on engineering in New Zealand and Australia prior to the founding of the national Societies was particularly strong, and especially in regard to admission, promotion and professional standards and the acquisition of technical information. This influence has continued to some extent since the national bodies came into existence in these two countries. The ASME - as well as the IMechE - has exerted influence on Learned activities in mechanical engineering in Canada.

* Professional registration and/or licencing have been concerns in all five countries, and especially in Canada and New Zealand, but the steps taken to deal with them have been different in each case. In Canada, the development of separate non-Learned Associations responsible for registration and licencing has also led to several attempts to 'confederate' the two aspects of the profession institutionally. (45)

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(1) The material for this paper was gathered principally from the following secondary sources:

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A.H. Corbett, THE HISTORY OF THE INSTITUTION OF ENGINEERS AUSTRALIA, The Institution of Engineers, Australia, in association with Angus and Robertson, Sydney, Australia, 1973

(2) James Kip Finch, THE STORY OF ENGINEERING, Doubleday & Co., New York, 1960, p xxiii

(3) Rolt, p 16

(4) Parsons, p 11

(5) Parsons, p 10; Rolt, p 17 and Illustration 10

(6) Mr Archibald Kintrea was the first (paid) Secretary of the IMechE but served for only a year prior to Marshall's appointment. The Stephenson comment can be found in Rolt, p 19

(7) (a) The IMechE Summer Meeting in Glasgow in 1856 led to the founding of the Institution of Engineers in Scotland - see CSME Bulletin, August 1994, pp 24-25

(b) Membership figures given in this paper refer to the totals for all grades at the time in question

(8) Parsons, pp 56-58

(9) ibid, p 66

(10) Rolt, p 121

(11) Sinclair, p 22

(12) ibid, p 23

(13) ibid, p 27

(14) ibid, p 24

(15) ibid, p 76

(16) ibid, pp 46 and 47

(17) ibid, p 85

(18) ibid, p 95

(19) ibid, p 111

(20) ENCYCLOPAEDIA BRITANNICA, 1959 Edition, Vol. 8, p 445

(21) Sinclair, p 161

(22) ibid, p 207

(23) ibid, p 206

(24) ibid, p 209

(25) THE ENGINEERING JOURNAL, June 1937, p 277

(26) ibid, p 277

(27) Canadian Society of Civil Engineers, TRANSACTIONS, Vol. I, Part II, 1887, p 279

(28) THE ENGINEERING JOURNAL, June 1937, p 279

(29) ibid, p 280

(30) THE ENGINEERING JOURNAL, April 1961, p i

(31) EIC Committee on Technical Operations, MINUTES, 11 November 1968, Appendix B

(32) Newnham, p 11

(33) ibid, pp 22-23

(34) ibid, p 24

(35) ibid, p 26

(36) ibid, pp 244-246

(37) ibid, p 67

(38) Corbett, p 17

(39) ibid, p 16

(40) ibid, pp 42-43

(41) ibid, pp 22-23

(42) ibid, pp 32-33

(43) ibid, pp 87-88, 110 and 111

(44) ibid, p 246

(45) In the case of the US, the source material - Sinclair's book - does not deal with registration/licensing issues or the American institutions involved. To do using other sources has, however, been considered outside the scope of this present paper.

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