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

by Andrew H. Wilson

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CSME History Committee

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)