

## CHAPTER 8

## 1945-50 FROM WAR TO PEACE

The war in Europe ended at midnight on the 8th-9th May 1945. Hostilities in the Far East continued but came to a dramatic conclusion as the result of the use of the atomic bomb on two Japanese cities.

The impact of scientific and technological development on the war effort resulted in a highly significant acceleration of technical innovation. This in turn had repercussions in peace time, which led to considerable social changes and ultimately to the serious consideration of the problem of pollution. The development of the atomic bomb led to the adoption of nuclear energy for peaceful purposes, including the generation of electrical power. Radar was another development that was quickly adapted for commercial use. Radio communication was also extensively developed during the war and the results were made available for civilian purposes.

Notwithstanding the bombing and the resulting war damage on Merseyside, the blackout and other difficulties that had persisted throughout the war, the Mersey & North Wales Centre had resolutely and successfully maintained its learned-society activities, albeit on a reduced scale, throughout the period of the emergency. The immediate postwar period saw the continuation of rationing and other restrictions, but large-scale reconstruction and planning provided incentives to the nation as a whole to establish a new and prosperous Britain.

It is interesting to record that the total membership of the Institution of Electrical Engineers in 1939 was 19 044. By 1945 this figure had increased to 26 665.

## 1945-46

The first meeting of the session was held at the Royal Institution in

October 1945, after members and visitors had been to Boots' Cafe for refreshments. J. Cormack introduced J. O. Knowles, M.A., and invited him to take the chair for the new session. Mr. Knowles then delivered his Chairman's Address on 'Staff functions and finance in expanding manufacturing companies'.<sup>1</sup> He was Chairman of the Brookhirst Switchgear Company mentioned in Chapter I, and became Chairman of Metal Industries in 1957-58. He became a prominent figure on the BEAMA and the IEC.

Arrangements were made for the holding of the annual dinner, and meetings in the months of December and January were to be resumed. It was also contemplated that the annual golf competition in aid of the Benevolent Fund, which had been abandoned during the war, would again be organized. During the war, special appeals had been made for financial support for the Fund. In the previous session a sum of £150 had been donated.

The meetings held during the first half of the session included a joint meeting with the Liverpool Engineering Society, at the Municipal Annexe, Dale Street, Liverpool, when J. Eccles, B.Sc., read a paper on 'Engineering tools, mental processes, materials, mechanistic skill, money and men'.

At the Committee meeting held at the University Club on the 3rd December, it was agreed that the Honorary Secretary should approach the University Librarian seeking full University Library facilities, including the loan of books, for members of the Centre. The Committee had, over a long period, donated a small sum annually to the University Library, and members were authorized to borrow books from the Departmental Library of Electrical Engineering. The Committee then expressed the view that members should be granted a concession to use the Departmental Libraries of Civil and Mechanical Engineering. In due course the University Library Committee agreed that members of the Centre could borrow books from any of the Departmental Libraries of Engineering.

The Annual Dinner Dance in aid of the Benevolent Fund, which had not been held during the war years, was resumed. The first of these functions took place in March 1946, at Reece's Ballroom, Liverpool. The tickets cost 15 shillings.

The Faraday Lecture entitled 'Atoms, electrons and engineers' by T. E. Allibone, D.Sc., Ph.D., M.I.E.E., was delivered on the 28th



March, at the Philharmonic Hall, Liverpool. The *Liverpool Daily Post* published on the following day suggested that no Faraday Lecture, probably no lecture of any kind given in Liverpool, had attracted such an attendance. The number present was 1770, of whom 1400 were visitors. Dr. Allibone was head of the Metropolitan-Vickers high-voltage research laboratory, and in his lecture discussed the discovery of the electron and the radioactive disintegration of elements which introduced a new concept of the atom. The lecturer suggested 'that the enormous energy in the nucleus may well have been harnessed before the middle of the 20th century'. In view of the popularity of the lecture Dr. Allibone agreed to repeat it on the 11th October.

On the 23rd May, the Benevolent Fund golf competition was held, for the first time after the war ended, at the Childwall Golf Club. It was open to IEE members and friends. The G. P. Dennis Trophy, held for one year, was awarded to the IEE member returning the best score against Bogey.

In the Report of the Committee for the 1945-46 Session, it was recorded that the average attendance for the 11 Ordinary Meetings held was 69.4, compared with nine Ordinary Meetings with an average attendance of 75.4 for the previous session. It also stated that the annual dinner was attended by 125 members and guests. The latter included the Lord Mayor of Liverpool (Alderman Luke Hogan, M.B.E.) and Dr. P. Dunsheath, President of the Institution.

#### 1946-47

R. Varley was Chairman for the 1946-47 Session, with P. C. Barnes as Senior Vice-Chairman, and T. B. D. Terroni as Junior Vice-Chairman. A. V. Milton was elected Honorary Secretary, and R. B. C. Stirrup Honorary Treasurer. The Committee appointed W. Parry Honorary Assistant Secretary, and E. G. Taylor agreed to act as the Local Honorary Treasurer of the Benevolent Fund.

The first Ordinary General Meeting of the new session was held in October 1946, when R. Varley delivered the Chairman's Address on 'Some aspects of railway electrification in Great Britain'.<sup>2</sup> The author considered that a great deal could be said for the electrification of Britain's railways. The prospect of saving nearly 10 million tons of

coal a year made it an attractive proposition. The Southern Railway (now the Southern Region of British Rail) had shown what could be done by electrification. The return on capital ranged from 14% to 27% in different areas. Electric traction gave the high degree of comfort and cleanliness in transport services demanded by the public. There was a possibility that the railways would be nationalized, but the change to electrification would still apply.

The railways were nationalized as from the 1st January, 1948, but large-scale electrification schemes were not undertaken until the London to Manchester & Liverpool lines were electrified in the 1960's, as described in Chapter I.

At the Ordinary General Meeting held in December, T. R. P. Harrison, B.Sc.Tech., (M), read his paper entitled 'The development of the gas-cushion cable system for the highest voltages'.<sup>3</sup> The author dealt with the development, design and manufacture of the gas-cushion cable, a solid cable injected with oxygen-free dry nitrogen after jointing and laying to permit the dielectric to operate under a minimum gas pressure of 200 lb/in<sup>2</sup>. The work had stabilised at 132 kV, but the author said it was already clear that higher voltages would be necessary. He added that on the continent satisfactory underground transmissions at 220 kV had already been accomplished.

During the Committee meeting held on the 3rd March 1947, the Honorary Secretary drew attention to the recommendation of the General Purposes Committee of the Institution that the necessary steps should be authorized for the erection of a plaque by the Institution on the house in Bold Street, Liverpool, in which the late Dr. S. Z. de Ferranti was born. At the Ordinary General Meeting which followed the Chairman welcomed members of local Gas Authorities, the Institute of Fuel, and the Institute of Heating & Ventilating Engineers, to hear a paper read by P. Schiller on 'Comparisons between gas and electricity on the basis of coal Economy'.

There was an attendance of 1700 people at the Faraday Lecture given at the Philharmonic Hall, Liverpool, by J. Hacking, M.I.E.E., entitled 'The generation and wholesale distribution of electricity'. The lecturer commenced by stating that the first public supply of electricity was inaugurated in 1881. He stressed the growth of demand and said the electrical supply industry had become a vital factor in the national economy. He emphasised that the enormous industrial



effort made during the Second World War had been possible because the country possessed a healthy electric supply industry. The lecturer traced the development of demand since 1920 and compared this with other forms of energy supply. He surveyed the nation's electricity requirements and the provision of large central stations for converting some form of energy into electrical form. Reference was made to the possibility of replacing steam turbines by gas turbines, and the prospect of utilizing atomic energy in place of coal was surveyed. The lecturer also discussed the attention that was being given to general district heating.

In July 1947, it was decided to terminate the arrangements for using the University Club for Committee meetings, and to hold them at the Royal Institution. It was also decided that the Committee should meet once a month during the forthcoming session.

#### 1947-48

Meetings in Liverpool continued to be held at the Royal Institution, Colquitt Street, but the Committee arranged to provide buffet refreshments before the meetings at the same place, instead of at outside premises, which had been the custom previously. This proved a useful and satisfactory innovation, and commenced at the beginning of the new session.

The Chairman for 1947-48 was P. C. Barnes, and the Vice-Chairmen were D. C. Fleming, M.Eng., and J. Eccles, B.Sc. A. V. Milton continued to act as Honorary Secretary, and W. Parry was elected Honorary Treasurer. Dr. J. M. Cowan continued to serve as Honorary Assistant Secretary. The Local Honorary Treasurer of the Benevolent Fund was E. G. Taylor, B.Sc.

The Chairman's Address entitled 'Some applications of electricity to glass manufacture' was given in October 1947.<sup>4</sup> The author, a member of the staff of Pilkington Brothers, discussed various operations concerned with the manufacture, examination and melting of glass, and the use of electrically-heated glass furnaces.

On the afternoon of the 3rd November 1947, a plaque marking the birthplace of the late Dr. Sebastian Z. de Ferranti, was unveiled at 130 Bold Street, Liverpool, where he was born on the 9th April 1864,

by his son, Sir Vincent Z. de Ferranti. Fig. 43 shows Sir Vincent, accompanied by P. C. Barnes, the Centre Chairman, at the ceremony. Further details of Dr. Ferranti will be found in Chapter 10, on the occasion of the centenary of his birth.

The first meeting to be arranged at Wigan was held at Wigan and District Mining & Technical College on the 9th December 1947, when W. A. Hatch, M.B.E., gave a popular lecture on 'Recent American hydroelectric schemes, with Special Reference to Boulder Dam'.

At the meeting held in March a paper entitled 'Centralized ripple control on highvoltage networks' by T. W. Ross, (M), and R. M. A. Smith, B.Sc.(Eng.), (AM), was read and discussed.<sup>5</sup> The term 'ripple control' described remote control by alternating-currents of audio frequency which are superimposed on power networks. The technique was introduced early in the century, but its application to large hv networks had only been considered during the past ten years. The authors reviewed the progress made during this decade and discussed the requirements of such systems. A method of network analysis was given for predetermining the ripple power required to give a desired signal strength, and for evaluating its degree of uniformity, on a known supply network.

The Faraday Lecture was given in the Philharmonic Hall on the 22nd March 1948. The lecturer on this occasion was Dr. P. Dunsheath, C.B.E., M.A., a Past-President of the Institution, whose lecture was entitled 'Electricity for everyman'.

In addition to the Benevolent Fund, the Institution was sponsoring a Homes Fund at this period, and each Centre was invited to help and was given a target figure. The latter, for the Mersey & North Wales Centre, amounted to £1539, and up to the 31st July 1948, a sum of £1152 had either been donated or subscribed under Deed of Covenant. This figure represented 74.89 per cent of target. The sum raised included donations totalling £413, received from electricity supply undertakings and large electrical manufacturers in the area, who had responded to a special appeal.

What was described as a very interesting development in the Committee's Report for the 1947-48 Session, was the holding of less formal District Meetings, which were intended to enable members working or living in outlying areas to participate in Institution activities.



Although the idea evolved late in the session two successful meetings were held. The suggestion that such meetings should be organized was made at the Committee Meeting held on the 2nd February, 1948. The first of these meetings took place at Bangor on the 22nd April when W. Fordham Cooper, B.Sc.(Eng.), read his paper on the 'Electrical control of dangerous machinery and processes', and the second at Wrexham on the 26th May, when G. T. Garwood, M.Sc., opened a discussion on 'The operational characteristics of modern h.v. woodpole lines'.

#### 1948-49

The Chairman for the new session was T. B. D. Terroni, B.Sc., and the Vice-Chairmen were J. Eccles, B.Sc., and E. W. Ashley, B.Sc., A. V. Milton continued as Honorary Secretary; W. Parry, M.Eng., remained Honorary Treasurer; Dr. J. M. Cowan remained as Hon. Assistant Secretary, and Mr. E. G. Taylor, B.Sc.(Eng.), again acted as the Local Honorary Treasurer of the Benevolent Fund.

The Chairman's Address was given on the 4th October 1948, and was entitled 'The telephone in communications'.<sup>6</sup> The author, who was on the staff of the Automatic Telephone & Electric Co., Ltd., discussed subscribers' apparatus, automatic exchange equipment, the trunk connection, and other trends. He mentioned the improved filter technique, and the design of electronic devices as factors in the development that had taken place up to the present.

One of the items discussed at the Committee Meeting arranged on the 18th October, was the possibility of setting up a Sub-Centre at Chester, but it was felt that further information should be made available before the proposal was discussed in detail.

Commencing in January 1949, the publication known as the *Journal of the Institution of Electrical Engineers* was replaced by a new monthly *Journal*, and the three parts of the *Proceedings of the Institution of Electrical Engineers* were published in alternative months. The *Proceedings* was formerly known as 'Abstracts'.

This session a Christmas Lecture for schools was organized by the Centre Committee. Attendance was limited to pupils at Liverpool schools, but representatives from other neighbouring Local Education

Authorities were invited to be present. The lecture was delivered by Prof. J. M. Meek, on the 4th and 5th January, 1949, and dealt with 'Lightning'. The venue was the Liverpool Collegiate School, Shaw Street, Liverpool.

Sir Noel Ashbridge, B.Sc.(Eng.), was the Faraday Lecturer for 1949, who took as his subject 'Television'. This was the year that the Birmingham station commenced regular television transmissions from Sutton Coldfield. The transmitter was the most powerful so far constructed, and although the range was nominally fifty miles, reception was good over considerably longer distances. The possibility of coloured television, and the use of a 625-line picture was already a topic of discussion.

At the final Committee Meeting of the session, held on the 4th July 1949, the Chairman, T. B. D. Terroni, expressed the congratulations of the Committee to J. Eccles on his nomination as Vice-President to the Institution. Incidentally, Mr. Eccles was elected President of the Liverpool Engineering Society for the 1950-51 Session.

In the 'Report of the Council for 1948-49'<sup>7</sup> a definition of the term 'professional electrical engineer' was given, evolved by the Institution's Education & Training Committee at the request of the Council, by whom it was approved, together with an explanatory note, as follows:

'A Professional Electrical Engineer is one who is competent through his education and training to assume personal responsibility for developments in electrical engineering; to apply the scientific outlook and method to the initiation, organization and supervision of technical work; to give authoritative technical advice; and to exchange ideas with his fellows for the general furtherance of science and its applications'.

'Explanatory Note: A Professional Electrical Engineer may be engaged in a branch of electrical engineering varying from heavy electrical machinery to electronic or ultra-high frequency devices in which his activities may range from sales engineering to fundamental research. His general and higher education, practical training and early experience, for which The Institution of Electrical Engineers requires certain standards, form a broad basis upon which subsequent technical and administrative responsibilities may be built'.

'Attainment of the degree of competence implied in the foregoing



will necessarily demand personal integrity as well as initiative and intelligence'.

#### 1949-50

In October, 1949, Mr. D. C. Fleming, B.Eng., delivered his Chairman's Address, entitled 'Staff problems in industry'. Twelve Ordinary General Meetings were held during the session, 11 in Liverpool and one in Chester. In addition, four District Meetings were arranged, two in Chester, one in Wrexham, and one in Llandudno Junction. The 1950 Faraday Lecture on 'Radar' was given by Dr. R. A. Smith, M.A., at the Philharmonic Hall, to an audience of 1700 people. Papers read during the session included 'The testing, reconditioning, and servicing of domestic appliances' by H. Hobbins; a lecture by J. Eccles, B.Sc., on 'Current Economic Problems', and 'The nature of the electric spark' by Prof. J. M. Meek, D.Eng., given at the rooms of the Liverpool Engineering Society.

A number of interesting items was discussed at Committee Meetings. Members residing in the Chester area requested that a Sub-Centre should be formed to include North Wales and Chester, and part of the Wirral. The suggestion was referred to the Standing Sub-Committee by the Centre Committee on a number of occasions. Ultimately it was resolved that five meetings should be held in the Chester area next session to obtain experience, before a decision was made. The Committee had learned with much pleasure of the award of Honorary Membership of the Institution to Prof. E. W. Marchant, which was particularly gratifying to the Centre, 'to the active life of which he had contributed so much since its inception'. The Committee were also very pleased to learn that Sir James Chadwick, C.H., F.R.S., had been awarded the Faraday Medal by the Institution. Sir James was a former Lyon Jones Professor of Physics in the University of Liverpool. He succeeded L. R. Wilberforce in 1935, and continued to occupy the chair until 1948 when he left Liverpool to become Master of Gonville and Caius College, Cambridge. It will be recalled that the first professor was Oliver Lodge. Sir James Chadwick discovered the neutron in 1932 at Cambridge and three years later was awarded the Nobel Prize for Physics. During his stay in Liverpool he 'brought immense prestige to the University'.<sup>8</sup>

Early in March, 1950, an invitation was received from the North-Western Centre for the Chairman and Committee to attend the Jubilee Exhibition which was held at the Manchester Central Library from the 6th to 25th March. The members' attention was also drawn to the publication entitled *The History of the North-Western Centre of the Institution of Electrical Engineers* by L. H. A. Carr, M.I.E.E., and published by the Institution. This book was re-issued in 1968 with an additional chapter by H. G. Bell, M.Sc.Tech., (F) covering the next 17 years.

E. G. Taylor, who had held the position of Local Honorary Treasurer of the Benevolent Fund for the past seven years, found he was unable to continue to hold the office, due to changes in his professional activities. During his period of service, in addition to members' subscriptions to the Benevolent Fund, Mr. Taylor had raised more than £2000 by special efforts which he had organized.

The nationalization of the power generation and distribution elements of the electrical engineering industry since the 1st April 1948, saw the beginning of a new era in planning on a national scale. Nevertheless, government restrictions on capital development led to load spreading and power cuts, notwithstanding an increase in generating capacity. The years 1949-50 saw the commencement of the new 275/300 kV supergrid by the British Electricity Authority, which was conceived originally by the former Central Electricity Board.<sup>9</sup>

The future of television was considered by a committee appointed to advise the government on the renewal of the Charter of the BBC, whose chairman was Lord Beveridge. One of the factors which had to be taken into consideration was the possibility of coloured television.

Limited progress was made in the atomic energy field. Two atomic piles were put into operation, both at Harwell. The first went into service in 1947, and the second followed in 1948.

In Liverpool, the electricity undertaking acquired by the Corporation in 1896 was retained until nationalization took place in 1948. Other municipal undertakings in the area were, of course, also taken over.



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## CHAPTER 9

## 1950-60 COURSE OF TECHNICAL CHANGE

The developments which took place in the decade 1950-1960 gave some indication of the pattern of postwar conditions in Britain, but progress was limited in the early years. Food rationing continued, and utility clothing and furniture were still being marketed in 1952. The factors affecting the economy remained sluggish and economic growth tended to be a planner's dream rather than a reality. Generating capacity was inadequate but the British Electricity Authority was hopeful that power cuts would end by 1956. Nevertheless, there were grounds for optimism and the swing back to peaceful conditions began to show results. As the years passed the characteristic signs of an expanding economy became more obvious. One signpost was electricity consumption which by 1958 was nearly double that of 1948, and almost four times greater than the figure for 1939. The development of large generating units and the increase in thermal efficiency proved to be two significant factors in considering the generation of electrical energy in relation to the economy.

The years 1950-60 saw some interesting and important technical innovations. One of the most noteworthy was the commissioning of the first commercial atomic power station, at Calder Hall, in 1956, 11 years after the first atomic bombs were dropped on Japan. The planning and construction of this station, incorporating gas-cooled reactors, involving the use of new materials and techniques of a very sophisticated nature. From both the scientific and engineering points of view, Calder Hall could be considered an outstanding success, and a truly British achievement. This enterprise pioneered the way for the provision of nuclear power stations using a new source of energy in the form of uranium, and generating electricity on an economic scale.

In 1959, a breeder reactor commenced working at Dounreay on an experimental basis, designed with a view to producing electricity at a low cost. At the time of its construction it was the largest reactor of its kind.

The first transatlantic telephone cable was laid in 1955-56 between the United Kingdom and North America, and opened for service in September 1956. It was also made available to European countries through circuits leased to the relevant authorities. Fig. 44 shows one of the three similar cables employed. They differed only in the armouring used, consisting of relatively small diameter high-tensile wires.

In 1952, an agreement was reached by the British Electricity Authority and Electricité de France (the French National Electricity Co.), both nationalized supply industries, to lay a cable between England and France, to spread peak loads between the two countries. However, it was not until 1961 that a link interchange came into operation, by means of twin cross-Channel cables, using direct-current at 200 000 volts. The project was based on the fact that the peak loads of the two countries varied sufficiently in time for such a scheme to have positive advantages.

The year 1955 saw the transmission of BBC sound programmes on very high frequencies (v.h.f.) with an initial range of about 50 miles. This development took place primarily to overcome interference from foreign stations that seriously affected reception using medium wavebands. At the same time, the quality of reproduction was considerably improved. Towards the end of the period under review the BBC was satisfied that a colour television service was practicable.

Considerable developments took place in the electronics field, following the invention of the transistor by a research team employed at the Bell Telephone Laboratories, USA, in 1948. The persons mainly responsible were J. Bardeen, W. H. Brattain, and W. Shockley. The latter eventually improved the original conception of this device by introducing the type known as the junction transistor. The original consisted of a crystal of germanium, but later it was found that silicon offered greater advantages. When it became a commercial proposition the transistor commenced to be substituted for the thermionic valve, invented by Prof. Ambrose Fleming in 1904. Various improvements took place which led to the production of the planar transistor, which permitted two or more transistors to be constructed in the same



silicon crystal. Electronic computers were built and employed for both scientific and commercial purposes in the 1950s. J. Lyons & Co. was the first organisation to use a computer for office work, which commenced to operate in 1953.

#### CENTRE ACTIVITIES

During the ten sessions between 1950 and 1960, the Mersey & North Wales Centre continued its activities on a more or less standard pattern. For example, in the 1950-51 session there were 14 Ordinary General Meetings, of which nine were held in Liverpool, and five in Chester, with an average attendance of 86.7. In addition, there were four District Meetings, and four Joint Meetings. A Summer Meeting, an Annual Dinner attended by 173 persons, and the Faraday Lecture, delivered to some 1700 people, were organized.

Fifteen Ordinary Meetings were held in 1959-60, of which ten were in Liverpool, and five in Chester. The average attendance was 71. There were nine District Meetings and some Joint Meetings were arranged. A Summer Visit was held, and also a Dinner Dance. The Annual Dinner attracted an attendance of 151. The Faraday Lecturer gave two performances to capacity houses at the Philharmonic Hall.

The Mersey & North Wales Students' Section held eight Ordinary Meetings; two District Meetings, and seven Works Visits were arranged in 1950-51. In 1959-60 17 meetings were held and six visits were organized, but the latter were not well supported.

#### 1950-51

The Chairman for the 1950-51 Session was J. Eccles, C.B.E., B.Sc., who was Chairman of Manweb, supported by E. W. Ashby, B.Sc., and H. C. Jones, O.B.E., B.Sc.(Eng.), as Vice-Chairmen; with A. V. Milton as Honorary Secretary, and W. Parry as Honorary Treasurer. Dr. J. M. Cowan and Mr. S. Towill acted as Honorary Assistant Secretaries. R. Varley became the Local Honorary Treasurer of the Benevolent Fund. The Chairman's Address was given in October and entitled 'Organization and management'.

The November Committee Meeting was held at Chester. The Honorary Secretary brought to the notice of members matters raised at a recent meeting of the Local Centres Committee of the Council, at which it had been suggested that Centres should encourage their members to prepare and present local papers of a less ambitious character than the normal IEE paper. They could be prepared as informal lectures on subjects of general interest and designed to promote discussion.

On the 23rd November, the Student Section Meeting developed into a lively discussion on the training of electrical engineers. S. J. Thompson had prepared a summary of the five reports published by the Institution since 1943, which recognised the needs of craftsmen, technicians, and professional engineers. It was suggested that improved courses of instruction were required for craftsmen and technicians. A number of speakers emphasised the importance of the Ordinary National Certificate course for technicians. Although courses should be designed to suit a particular group of personnel, it was agreed that they should also be sufficiently flexible to permit the transfer of students from one course to another.

The 1951 Faraday Lecture on 'Lights and lighting—A record of industrial research' was given by L. J. Davies, M.A., B.Sc., at Liverpool, to an audience of some 1700 people.

The Centre Committee had been considering the possibility of setting up a Sub-Centre in Chester. At a meeting held in March it was resolved to hold a further five meetings in Chester during the coming session, and to give the present arrangements a further 12 months trial, before considering the proposal again.

#### 1951-52

E. W. Ashby, B.Sc., succeeded to the Chair for the 1951-52 Session, with H. C. Jones, O.B.E., B.Sc.(Eng.), and W. A. Hatch, M.B.E., as Vice-Chairmen. The Officers remained the same as for the previous session, with the exception that T. B. D. Terroni, B.Sc., became Local Honorary Treasurer of the Benevolent Fund.

The Chairman's Address, entitled 'Electricity in marine Services',<sup>1</sup> was concerned with the use of electricity in connection with ships



services. Steam-turbine electric drive, Mr. Ashby felt, was now firmly established as a recognised means of propulsion for passenger ships, cargo liners, and tankers. During the course of his address he described the use of radar, coupled with a system of radiotelephony, employed on the River Mersey and the approach channel, which was evolved during the Second World War. He mentioned also the similar methods used by the cross-river ferry traffic between the Liverpool landing stage and the Seacombe and Woodside stages in fog conditions.

'Electricity in newspaper printing' by A. T. Robertson was read at a Chester meeting in January, 1952.<sup>2</sup> The author stated that in 1951 there were 44 morning and 82 evening papers printed daily in Great Britain, of which 17 morning and 3 evening papers were printed in London. There were also 10 national Sunday newspapers. Some of these papers were printed in Manchester, Glasgow and London. In addition, many districts had their own weekly papers. The *Liverpool Courier* installed an electric drive in 1898, to provide a smooth speed control. By 1900 about 50 British newspapers had adopted electric drives. Since 1901 or thereabouts, all new newspaper presses had been driven electrically. During the course of his lecture the author dealt with the processes involved and the electricity-supply requirements.

In February, 1952, Mr. P. Bingley, (AM), read his paper on 'Characteristics and control of rectifier-motor variable-speed drives'.<sup>3</sup> The author dealt with mercury-arc rectifiers, mainly of the glass-bulb type, used with shunt wound d.c. motors to provide variable-speed drives for industrial machinery. In Mr. Bingley's view, the mercury-arc rectifier was 'a worthy competitor of the Ward Leonard drive. It was important to design the unit after the whole drive had been fully considered. The very small number of moving parts gave the mercury-arc rectifier a definite advantage over the Ward Leonard set'.

The Faraday Lecture for 1952, entitled 'Sound Recording—home, professional, industrial and scientific applications', was given by Dr. G. F. Dutton, Ph.D., B.Sc.(Eng.), at the Philharmonic Hall as usual, in March, to a capacity audience.

The Annual General Meeting also took place in March and A. R. Cooper, who had left the Centre during the session to become the North-Western Regional Controller of the BEA, gave a farewell talk on 'People', a study of the art of living.

1952-53

When the Committee held its first meeting on the 6th October 1952, the Chairman, E. W. Ashby reported that the President and Council of the Institution had received a letter from the Keeper of Her Majesty's Privy Purse, granting Her Majesty's patronage of the Institution. W. A. Hatch was then installed as the new Chairman. He delivered his Chairman's Address entitled 'The manufacture of sheet glass' at the Ordinary General Meeting which followed. Although sheet glass had been made in other countries some thousands of years earlier, the speaker said that the first sheet of glass made in Britain was produced at Chiddingfold, in the Weald, in the year 1226. He described the crown process in which a flat sheet was produced from a hollow sphere. The hand cylinder process was introduced about 1840, followed by the cylinder-drawn process, during which the glass was finally flattened in a kiln, but the surfaces remained uneven. In 1926 the flat-drawn process greatly improved the flatness.

Later in October a paper on 'The application of transducers as relays to protective gear' was presented by R. K. Edgley, M.Sc.(Eng.), (AM), and F. L. Hamilton, B.Eng., (AM).<sup>5</sup> Transducers were a popular subject for discussion at the time, and a number of papers had recently been published about them, concerned primarily with those operated from voltage sources. When they were operated from current sources their field of application was widened. The authors' aim was to describe some of the ways in which transducers could be used 'to give to simple relay elements some of the special characteristics required in protective-gear work'. The authors demonstrated that the transducer was a very versatile component for protective systems.

During 1952, the Centre Committee had set up a Sub-Committee to examine the training, promotion, prospects, and the status of marine electrical engineers. A report was prepared and circulated to the Centre Committee for consideration.

At a Committee Meeting held in July 1952, members were informed that the Centre had not been selected as a venue for the current Faraday Lecture. However, A. R. Cooper, a former member of the Centre, who was presenting the lecture, agreed to visit Liverpool and the Committee undertook to be responsible for the expenses



involved. The lecture, entitled 'Light from the Dark Ages or The evolution of electricity supply', was duly delivered in January 1953, in the Philharmonic Hall, to a large audience.

During the decade 1950-60 the Government gave increasing attention to the needs of technical education, and the Council of the Institution discussed the question of the allocation of government grants to selected technical colleges, which aimed to raise the status of Technological Education. This matter was discussed by the Centre Committee in March, 1953, when it was learnt that the Liverpool College of Technology had failed to qualify for such a grant. It was decided that the Chairman and Mr. J. Eccles should consider an approach to the Director of Education to see what could be done to make Liverpool eligible for the new grant. Happily, the position was rectified in due course.

#### 1953-54

Newly elected officers for the 1953-54 Session were T. Coates, M.Eng., Chairman; Prof. J. M. Meek, D.Eng., Vice-Chairman, and J. W. Lynn, B.Sc., became Honorary Assistant Secretary. J. Cormack and G. T. Richards were appointed Honorary Auditors. D. A. Picken was invited to become the Local Honorary Treasurer to the Benevolent Fund. Prof. Meek was also appointed Assessor for the Student Section Local Centre Prize Committee.

The Chairman's Address, entitled 'Progress and problems of electricity supply', commenced with an historical review of the distribution and sale of electricity.<sup>6</sup> He then considered systems of supply, capital growth, and the expansion of sales which began in 1896. He quoted the following figures:

<i>Year</i>	<i>Millions of kWh</i>	<i>Year</i>	<i>Millions of kWh</i>
1896	30	1930	9 000
1900	125	1940	24 000
1910	1 000	1950	45 000
1920	3 000		

For 1952-53 the sales were 52 250 million kWh (The above figures can be compared with that for 1971-72, which was 177 679 million kWh).

Mr. Coates then discussed price variations in the form of increases and decreases. When sales first commenced the average price per kilowatt hour was about one shilling (five new pence). This fell to a little over 2d in 1900 and dropped to 1½d in 1918-19. In 1939, it had fallen to 1.02d per kWh, after which it commenced to rise, slowly but steadily. In 1952-53 the price had risen to 1.31d, when coal cost 69s a ton. Up to 1914 coal had been priced at 10s per ton, but, in that year it rose to 17s.

A paper read at an Ordinary General Meeting held at Chester in December was entitled 'Electricity in farm crop drying' by C. A. Cameron-Brown, B.Sc., and P. G. Finn-Kelcy.<sup>7</sup> The authors considered the basic principles of farm crop drying, grain drying and hop drying. They concluded that 'the need and demand for drying is increasing and the form of development becomes ever more favourable to the use of electricity for heating'.

Early in 1954, J. Eccles, C.B.E., B.Sc., a Vice-President of the Institution, and a Past-Chairman of the Centre, resigned from the Centre Committee on account of his new appointment as Deputy Chairman (Operations) of the British Electricity Authority, which meant residing in London. Later in the session, members learnt with great pleasure that Mr. Eccles had been elected President of the Institution for the 1954-55 Session.

The Committee Meeting held in February at Chester was attended by Sir George Nelson, a Vice-President of the Institution. The Honorary Secretary gave a résumé of the progress made regarding the training and responsibilities of marine electrical engineers. Arrangements for an open discussion on the subject were proceeding, and Messrs. Ashby and Peacock were invited to attend a meeting of a small panel of members to discuss the final arrangements. Then followed a joint meeting with the North-Western Centre, when Dr. B. V. Bowden, M.A., Ph.D., (later Lord Bowden) presented a paper entitled 'Faster than thought', which considered the prospect of the 'revolutionary changes on office procedure from the development of electronic digital computers that could be programmed to carry out much routine clerical work'.<sup>8</sup>

Further details regarding the Institution's interest in marine electrical engineers were given to the Centre Committee in July, when the Honorary Secretary read a draft letter which the Council had



authorised the Secretary of the Institution to send to the Ministry of Transport & Civil Aviation, recommending the establishment of a section, or department, within the Ministry, to specialize on the electrical engineering aspects of marine engineering.

The 1954 Faraday Lecture entitled 'Electroheat and prosperity', was given by O. W. Humphreys, B.Sc., in Liverpool.

#### 1954-55

J. Eccles, C.B.E., B.Sc., served as President of the Institution of Electrical Engineers for the 1954-55 Session, the second Past-Chairman of the Mersey & North Wales Centre to achieve this high office (Fig. 45).

Josiah Eccles, C.B.E., D.Sc., M.Inst.C.E., M.I.Mech.E., M.I.E.E., was born in Ulster in 1897. He served in France during the First World War, and was awarded the Military Medal. In 1917 he gained a commission on the field of battle. Following the cessation of hostilities, he became an undergraduate at the College of Technology, Belfast, where he studied electrical engineering. He graduated B.Sc., with First Class Honours. In 1956, he was awarded the honorary degree of D.Sc. He entered the electrical engineering industry in 1922 and spent several years with Metropolitan-Vickers Electrical Co. Ltd. Later he obtained a post with the Edinburgh Corporation Electricity Department, and ultimately became Engineer and Manager. In 1943 he succeeded the late P. J. Robinson as Liverpool's City Electrical & Lighting Engineer, a position he held until 1948, when he was appointed Chairman of the Merseyside & North Wales Electricity Board. In 1954 he became Deputy Chairman of the British Electricity Authority, and in 1957 until 1961, of the Electricity Council.

Eccles was President of the Incorporated Municipal Association during 1947-48, and Chairman of the British Electrical Development Association in the year 1948-49. He served as President of the Liverpool Engineering Society during the 1950-51 Session. For a period, he was a member of the Scientific Advisory Council. He was awarded the C.B.E. in 1950 and seven years later received a knighthood.

Sir Josiah Eccles was a very active member of the Institution of Electrical Engineers. He was elected an Associate Member in 1928, and a Member (old style) in 1938. He served as a Member of Council

and was elected Vice-President in 1948. and President during 1954-55. He was a keen supporter of the Mersey & North Wales Centre, and served as Chairman during 1950-51. He published many papers on the subject of electrical engineering and related subjects. He died in 1967 at the age of 70.

In his Inaugural Address<sup>9</sup> as President, delivered before the Institution on the 7th October 1954, Mr. Eccles made some observations of a general character 'on the long-term past and future of power engineering'. He understood the function of the power engineer was:

'... to give man command over Nature by releasing her great storehouse of energy and presenting it in forms and quantities that, at one end of the scale, enable him to achieve the otherwise impossible, and at the other, enable him to gain a livelihood without undue physical exertion'.

The President looked briefly at the nuclear power possibilities:

'From published data on the fission of uranium, it would seem that the process can be controlled in such a way as to liberate heat at a temperature suitable for industrial power purposes, but that before efficient large-scale nuclear power stations are practicable, work has to be done on heat transfer methods and materials and on the treatment of the products other than heat which forms part of the process. There can be little doubt that these problems will be solved if the need to do so is sufficiently great'.

Later in his address Mr. Eccles said:

'There are some who argue that, because it is now theoretically possible for nuclear power to satisfy man's total demand for energy, the pursuit of all other sources should be abandoned. I do not share that view. There are problems to be solved before the energy of fission becomes a reality on a large scale. The chemical process of uranium separation and purification will itself consume a considerable amount of energy, and in any event the alternative sources will be fully competitive for many years to come'.

During Mr. Eccles' presidency the total membership of the Institution of Electrical Engineers reached 39 298, including more than 20 000 corporate members.

Reverting to the activities of the Centre, T. Coates vacated the Chair, and welcomed the new Chairman, P. R. Dunn, B.Sc., and the new Honorary Secretary, J. W. Lynn at the Committee Meeting held



in October 1954. A Barograph was presented to the retiring Honorary Secretary, A. V. Milton as a token of appreciation from the members. At the Ordinary General Meeting which followed Mr. Dunn delivered the Chairman's Address on 'Cables—some postwar trends'.<sup>10</sup> The author, who was with British Insulated Callender's Cables Ltd, outlined some of the more recent developments in the materials and processes used for cable making since the ending of the artificial conditions which existed during the war. Copper remained virtually unchallenged as a conductor, except for some high-temperature applications when conductors were electroplated with nickel or silver. The use of aluminium presented no difficulties technically, but it was more costly and required additional insulating and protective materials. Rubber manufacturing techniques had improved and vulcanization was increasingly being adopted. Polychloroprene was the only synthetic material developed abroad which was used extensively for cable-sheathing and as a protective covering in aircraft. Various plastic materials developed during the war were widely used. They included polyvinylchloride (pvc) and its copolymers, polyethylene, polystyrene, polytetrafluoroethylene, and nylon. Papers and compounds had improved in quality. The postwar scarcity of lead resulted in the use of other materials including aluminium which made armouring unnecessary for most uses. It also obviated the need for reinforcement in pressurized cables. Mr. Dunn stressed the use of plastics which led to the evolution of new types of cable suitable for telecommunication, radio and electronic equipment. In the very high-voltage field he discussed the four main types of pressurized cables, namely oil-filled, gas pressure, compression, and pipe cables.

Fig. 46 shows telephone cables being manufactured at Prescott (BICC) in 1920.

Examples of 600–1000 V distribution cables manufactured by BICC over a period of about 50 years can be seen in the following illustrations:

Fig. 47 shows a paper insulated, lead sheathed cable, first produced in the 1920s, and which continues to be used. It has copper conductors. Over the years, the insulation and lead thicknesses have been reduced considerably.

Fig. 48 illustrates a 3-core cable, single-wire armoured, p.v.c. insulated, with solid aluminium conductors. It was introduced

in the 1950s and is used mainly in industrial premises. It represents the first change from the use of paper insulation for power cables.

Fig. 49 shows a 'Consac' cable, which resulted in the first major change made by the Electricity Boards to economize by utilizing a concentric neutral cable of 3-core design, employing solid aluminium conductors. It was introduced in the 1960s and its size was much reduced compared with cables used previously. Incidentally, the Electricity Boards had also adopted stranded aluminium conductors in the conventional 4-core PILS cable by the 1960s.

Fig. 50 shows a 'Waveconal' cable employing a combined neutral and earth conductor, consisting of a concentric layer of aluminium wires applied in a sinusoidal formation, sandwiched between layers of unvulcanized synthetic rubber compound to give maximum protection against corrosion. It was introduced in the 1970s for use by the Electricity Boards, and represents their first adoption of synthetic insulation. Its construction is economical and permits simplified jointing procedures to be adopted.

On the 16th November 1954, the Institution of Electrical Engineers celebrated the Jubilee of the Thermionic Valve, 50 years after Prof. Ambrose Fleming patented his diode. During the week in which the Jubilee was celebrated, an exhibition showing the various stages of development from the original Fleming diode to the travelling wave tube employed at the time.

During 1954 the Council of the Institution were concerned about the low rate of recruitment of students. The views of the Centre Committee were that the postwar peak of students at universities and technical colleges had declined and there were fewer students to apply for membership. Students often found it difficult to find time to participate in Institution activities. The Committee was of the opinion that the advantages of membership were not always apparent, and that suitable literature should be made available to encourage membership. Many students were unwilling to pay Institution fees during their period of National Service, and this matter was under consideration by the Council. Another factor was the rising standard of the Institution's examinations. The Committee was anxious not to encourage applicants who were not likely to meet requirements.

The problem was referred to again in January 1955, when Mr.



Brasher's reply to the comments forwarded by the Committee was read. Many students could see no advantage in Student Membership. Many of the papers read were more suitable for graduates of the Institution. Attendance at evening classes often made it difficult for students to attend meetings. Increases in fees could deter many students from joining the Institution. After National Service, students might find it more suitable to defer joining the Institution until they could qualify as graduates. Another criticism was that meetings were too formal. The activities of Works Engineering Societies could clash with Student meetings. It was also alleged that there was a lack of interest at technical colleges and universities in the Students Section. The Centre Committee agreed that a Sub-Committee should be formed under the chairmanship of Prof. Meek to consider the Students' comments.

T. B. D. Terroni, a Past-Chairman of the Centre, was honoured this session by being selected to give the Faraday Lecture entitled 'Courier to carrier in communication', which was delivered in Liverpool on the 6th December, 1954, and in London in January 1955.<sup>11</sup> Mr. Terroni, who had been associated with the Automatic Telephone & Electric Co. over a long period, traced the history of the methods of communication from ancient times to the present day. The principles of the dialling telephone and switching equipment used in a telephone exchange were demonstrated. The lecturer illustrated the use of a magnetic drum acting as a storage device for the automatic selection of routes when the normal route was blocked by excessive traffic. He discussed the development of multichannel communication, and gave a demonstration showing how speech could be transferred to different parts of the frequency spectrum. Further demonstrations showed how separate conversations could be simultaneously carried over the same system. Films were used, one of which traced the path of a telephone call from Britain to New York.

In January 1955, during the presidency of Mr. Eccles, the Institution introduced a new series of the *Journal*. The Council's aim was to ensure 'that there should be a publication common to all members of the Institution, which all would desire to read.' It was intended to include new features whose aim would be to illustrate and interpret the record of progress made in electrical engineering and published in the *Proceedings*.

1955-56

Prof. J. M. Meek, D.Eng., was welcomed as the new Chairman when the Committee met in October 1955. In the evening he delivered his Chairman's Address on 'Electrical discharges in gases'.

The technical papers read at meetings included 'High-speed electronic analogue computing techniques' by D. M. McKay, B.Sc., Ph.D.; 'Transistor power amplifiers' by R. H. Hilbourne, B.Sc., and D. D. Jones, M.Sc.; 'Electrical systems, fault power and the selection of switchgear' by P. d'E. Stowell, B.Sc.(Eng.); 'A transatlantic telephone cable' by Sir Gordon Radley and others; and 'Problems of hydro-electric designs in mixed thermal-hydroelectric systems' by T. G. N. Haldane, M.A., and P. L. Blackstone, T.D., M.A. The Centre also collaborated with the Liverpool Technical Library in presenting a public lecture on the 'Application of digital computers' by Dr. T. Kilburn.

In July, the Committee congratulated J. Cormack on the award of the O.B.E., and A. V. Milton on his having been elected President of the Electrical Contractors Association for the coming year.

1956-57

The Officers for the 1956-57 Session were: P. d'E. Stowell, B.Sc.(Eng.), Chairman; E. J. Evans, M.Sc., and T. Makin, Vice-Chairmen; S. Towill, B.Sc., Honorary Secretary; W. Parry, M.Eng., Honorary Treasurer; G. W. Barlow, B.Sc.Tech., Honorary Assistant Secretary, and D. A. Picken, Local Honorary Treasurer, Benevolent Fund.

The Chairman's Address, entitled 'A review of some aspects of electricity distribution', was given at Liverpool in October 1956, and was repeated at four District Meetings. The author, who was Chief Engineer of MANWEB, discussed some aspects of electricity distribution in the area of the Mersey & North Wales Electricity Board. He mentioned three periods, the first, the d.c. era, when a small radius was served by a local power station. The second period followed the development of a.c., usually generated at 6.6 kV, when distribution distances greatly increased, mainly through supplies provided by local



power stations, the third era commenced with the introduction of the 132 kV Grid, under the 1926 Electricity Act, but the distribution system continued to be centred on a single supply point, 'because, although the Grid did interconnect generating stations, certain provisions of the Act made it uneconomic for most undertakings to take a supply at more than one point'. The next stage was one of complete integration, which started in 1948, following the coming into force of the 1947 Electricity Act.

The author then discussed in detail the distribution networks in the MANWEB area, the impact of larger loads, high-voltage distribution, transformer arrangements, feeding arrangements for the 33 kV network, and matters affecting switchgear and protective devices. In his concluding remarks Mr. Stowell could not foresee any development 'that could vastly affect the course of progress in electricity distribution'. He thought nuclear engineering might do so eventually, but he considered it was unlikely to be distributed other than in the form of electricity.

A number of interesting papers were read during the session including: 'Germanium and silicon power rectifiers' by T. H. Kinman, M.B.E., and others; 'Domestic heat pump Installations' by G. O. McLean, M.Eng.; 'Control of nuclear reactors' by J. Walker, M.A., and R. J. Cox, B.Sc.; 'BBC sound broadcasting on v.h.f.' by H. Page, M.Sc., and H. A. Hayes; and 'The potentialities of railway electrification at the standard frequency' by E. L. E. Wheatcroft, M.A., and H. H. C. Barton, B.A.

The Faraday Lecture was not given at Liverpool in 1956. However, this session Dr. T. E. Allibone delivered the lecture entitled 'Nuclear energy in the service of man', in April 1957, to an audience that filled the Philharmonic Hall. Incidentally, the lecture was televised by the BBC on the 12th March 1957. Dr. Allibone commenced by outlining the anatomy of the atom and then surveyed the principles of reactor design, followed by a description of a number of power reactors. The lecturer expressed the optimistic view that the difficulties of achieving and controlling thermonuclear reaction would be overcome in the relatively near future. He then explained how the byproduct of fission would be used in medical science, in industry, and in agriculture.

At the Committee Meeting held in April, consideration was given to the boundaries of the Mersey & North Wales Centre. The Com-

mittee decided to recommend that the boundaries should be adjusted to incorporate the following changes:

- 1 Wigan to be transferred to the North-Western Centre.
- 2 The Mersey & North Wales Centre should be extended to include Northwich, Crewe, Oswestry, Aberystwyth, and the Isle of Man.

These proposals were considered by the Council who agreed that Oswestry and Whitchurch would be ceded to the Centre, but Wigan would be retained, as no agreement on the proposed transfer could be reached with the North-Western Centre.

The Centre's Annual Summer Meeting held in 1957 took the form of a visit to the atomic power station at Calder Hall (which had commenced operation the previous year) and the Lake District. A special train took some 200 members and friends on what proved a very successful outing.

The *Journal* for 1957 included an article by Mr. J. Eccles entitled 'Three weeks in the USSR'.<sup>13</sup> It gave an interesting account of the visit made by a delegation from the British electricity supply industry to the Soviet Union. The party of 19 was led by Lord Citrine, who was the first Chairman of the British Electricity Authority set up in 1948. Brief surveys were included of the territory and government of the USSR, its economic organization, the wage structure and trade unions, industrial development, and research activities.

1957-58

The Chairman for 1957-58 was T. Makin, and the Vice-Chairmen, T. A. P. Colledge, and J. Collins. Dr. J. N. Fletcher became an Honorary Assistant Secretary, and E. W. Ashby was appointed Honorary Editor. The topic of the Chairman's Address was 'The development of electrical services in a soap and chemical factory'.<sup>14</sup> The author described the electrical services in the factory owned by his firm, Joseph Crosfield & Sons Ltd., of Warrington (now part of the Unilever group). It had 27 acres of floor area devoted to manufacturing purposes. Electricity was first used in 1900 when a 15 kW, 230 volt, d.c. gas-engine driven generator was installed to



supply carbon-filament lamps. Between 1900 and 1956 the energy used increased from 3000 to 26 million kWh per annum.

A comprehensive range of topics was included in the programme for the session ranging from nuclear energy to colour television. One meeting was devoted to a discussion on the report entitled 'Supply and training of teachers for technical colleges', introduced by Dr. Willis Jackson, F.R.S., who became Lord Jackson of Burnley. He spent some time at Metropolitan-Vickers as personal assistant to Sir Arthur Fleming, and then held Chairs at the University of Manchester, and the Imperial College of Science & Technology at South Kensington. His interests ranged over many fields. In particular he devoted much time and effort to the solution of manpower problems. Sir Willis Jackson, as he then was, served as President of the Institution of Electrical Engineers during 1959-60. He died in 1970 aged 65.

The Faraday Lecture was given on the 6th March 1958. It was entitled 'Electrification of the British Railways', and was prepared by Mr. G. H. Fletcher, who gave the lecture on three occasions before he died. The full course of lectures was completed by R. Ledget, who visited Liverpool and gave the lecture in the afternoon and evening.<sup>15</sup> The lecturer dealt with various proposals put forward by the British Transport Commission for railway electrification. He explained the reasons which had made electrification at 25 kV a possibility, and how this could reduce the number of sub-stations from 70, if a supply at 1500 Volts, d.c., had been used, to 12. The saving of coal was demonstrated through improved thermal efficiency. Various other topics were touched on, including the principles of automatic train control.

One of the District Meetings was arranged in Douglas, Isle of Man in May 1958, the first to be held on the island.

On the 18th May 1951, the President of the Institution formally opened 'The Chesters' at Malden, Surrey, which was designed to be 'A living memorial to commemorate those members of the Institution of Electrical Engineers who gave their lives for their Country and in the Cause of Freedom during the War of 1939-1945'. The estate was presented by C. W. Speirs, J.P., M.I.E.E., and the fund for its development was raised by subscriptions by members of the Institution.<sup>16</sup> By 1958 the 6-acre site contained 16 houses and flats. Homes were made available by the Governors of the Institution's Homes

Fund, to retired or incapacitated members of the I.E.E. and their dependants who had fallen upon hard times. Houses were let, either at a nominal rental, or rent free.

#### 1958-59

J. Collins became Chairman for the 1958-59 Session, with T. A. P. Colledge and D. A. Picken as Vice-Chairmen; S. Towill and W. Parry continued to hold their respective positions as Honorary Secretary and Honorary Treasurer. The Honorary Assistant Secretaries were D. Boyd and Dr. J. N. Fletcher. Mr. Picken also continued to hold the post of Local Honorary Treasurer to the Benevolent Fund.

'This exciting industry' was the subject of the Chairman's Address.<sup>17</sup> The author, who was with the English Electric Co. Ltd., considered the scope and associated activities of the electrical engineering industry, and the 'bewildering choice of interests' which confronted the modern young man entering a technical career. He stressed the attraction of participating in great projects, and mentioned the growing interest in the application of nuclear power and electronics. Mr. Collins also discussed the influence of education and dealt with various aspects of co-operation with industry.

At the Committee Meeting held in October 1958, the Chairman proposed that an Education Sub-Committee should be set up of all members of the Centre Committee who were on the Board of Governors of local technical colleges. The first meeting of the Sub-Committee was held on the 19th January 1959, and the members elected to serve were: J. Collins, A. V. Milton, R. N. Pegg, G. R. Harding, J. M. Meek, and S. Towill. The following members were co-opted: M. Houghton, J. Cormack, A. R. Kinsman and J. E. Macfarlane.

The Faraday Lecture was given in February 1959, by Dr. H. A. Thomas, D.Sc., M.Sc., M.I.E.E., a former member of the Centre Committee, and took as his subject 'Automation'.

#### 1959-60

The Chairman for the new session was T. A. P. Colledge,



B.Sc.(Eng.), who chose the 'Development of the telephone system in Great Britain' as the subject of his Chairman's Address.<sup>18</sup> The author, who was a member of the Post Office Engineering Department, began by explaining that it was only recently that the type of telephone invented by Bell had been superseded, using the 'rocking-armature' receiver. Although the modern transmitter was the result of considerable change in detail, it remained based on Prof. Hughes's invention. Reference was made to many innovations.

In 1959 the Committee decided that the annual dinner should be held alternatively in Liverpool and Chester. Other matters discussed included the possibility of co-operation between engineering institutions on Merseyside, following proposals made by the Liverpool Engineering Society, but the idea did not materialize.

The Faraday Lecture on 'Electrical machines' was delivered by Prof. M. G. Say, Ph.D., M.Sc., F.R.S.E., in March 1960, to two audiences.

The programme of lectures for 1959-60 included a variety of subjects. The following are examples: 'Subscriber trunk dialling' by D. A. Barron, M.Sc.; a symposium on 'The provision of adequate electrical installations in buildings' by R. A. Marryatt, B.Sc.(Eng.), and others; 'Research on the performance of h.v. insulators in polluted atmospheres' by J. S. Forrest, M.A., B.Sc., and others; 'Plastic power cables' by P. Panton; 'Deltic locomotives' by C. M. Cock; 'Characteristics and protection of semiconductor rectifiers' by D. B. Corbyn, B.Sc.(Eng.), and H. L. Potter, B.Sc.(Eng.), and 'High-voltage switch-gear for distribution systems' by T. Smith.

During the Summer a visit was made to see construction work at the Blaenau Ffestiniog Pumped Storage Scheme, and the Trawsfynydd Nuclear Power Station.

## CHAPTER 10

### 1960-73: THE END OF AN EPOCH

Technological advance continued to accelerate during the period under review, particularly in the electronics field. This can be appreciated by reference to the literature, which had been published on an international scale. The publications of the Institution of Electrical Engineers alone give some indication of the trend. During the past decade or so, there were phenomenal changes. For example, in telecommunication the introduction of communication satellites, coupled with improvements in telephony, have, for most practical purposes, eliminated the problem of distance. The introduction of the waveguide; semiconductors; integrated circuits; microwaves, which have made possible communication and other activities associated with spacecraft; coaxial cable transmission systems; printed circuits, and other techniques indicate the lines on which progress has been made. Many other examples could be given of advances in electrical engineering which have contributed to the formation of the technological society in which we now find ourselves.

The term 'the end of an epoch' can be considered in a number of ways. Internationally, the effect of scientific advance and technological change was suddenly brought into focus, when the actual and potential effects of pollution on the environment brought a sharp reaction. The period also saw many social changes, due partly to technological change and other factors, but also to the expansion of general and higher education, coupled with the dissemination of news and current events to mass audiences. These circumstances led to a new awareness in people in all walks of life. On a more limited scale, the organization and activities of the professional engineering institutions were sharply criticised, and the institutions themselves



began to consider their future development in a changing society.

From the point of view of the Mersey & North Wales Centre, the Jubilee Year may well prove to be the end of an epoch during which the professional institutions thrived and prospered, and whose authority and standing were clearly recognisable. Changing conditions are bound to be reflected in the character of the institutions, including their local centres. How they will evolve is a matter of conjecture.

From the end of the Second World War to the early 1960s the Mersey & North Wales Centre of the Institution of Electrical Engineers continued its learned society activities according to a pattern with little variation. Similarly, a limited number of social functions were arranged and supported by the members. At the same time, the Graduate & Students Section provided a programme of meetings, visits and social activities which did not alter materially from session to session. However, there were periods when the support anticipated by the Committee of the Section was not forthcoming and, as a result, the overall activities tended to be reduced, and the social events ceased to be organized. But the programme of meetings maintained a high quality, and the visits were varied and embraced a wide range of interests.

The Centre's first innovation appeared in the 1961-62 Session, when an *ad hoc* committee was formed with Mr. J. Durnford as Chairman, and J. Caird as Honorary Secretary, to explore the interest of the Centre in an Education Discussion Circle. Following the committee's recommendation the Centre Committee made formal application to headquarters for permission to operate an Educational Group within the new Divisional Structure, which was granted by the Council. Towards the end of 1962 the name of the proposed Circle was changed to Education & Training Circle. Its first meeting took place on the 11th February, 1963, when more than 40 persons attended.

Although the second innovation followed the first, it had been discussed earlier, and referred to the formation of Specialized Sections. Following agreement by the majority of members that this would be desirable (and with the approval of the Council), an attempt was made to coincide the setting up of the Sections with the commencement of the new National Divisional Structure of the Institution in October 1962. However, other factors intervened and it was decided to postpone sectionalization for 12 months. Nevertheless, two Section Committees

were formed. The first was the Electronics Section Committee with Dr. J. B. Higham as Chairman, and H. V. Bell, B.Sc., as Honorary Secretary. The second was the Power Section Committee under the chairmanship of F. C. Walmsley, and Mr. C. E. R. Fairburn agreed to act as Honorary Secretary. The introduction of sectionalization led to additional meetings and an expansion of the Centre's scientific and technological interests. On the other hand, the Committee and many members of the Centre were concerned with the possibility 'that forming specialized groups might in fact split our ranks and form three completely isolated groups which had little or no contact with each other'. Fortunately, these fears did not materialize.

#### 1960-61

D. A. Picken was Chairman of the Centre during the 1960-61 Session. He chose for the title of his Chairman's Address 'The effect of electricity on human beings'.<sup>1</sup> As H.M. Electrical Inspector of Factories, Mr. Picken was well qualified to discuss the effects of the passage of electric current through various parts of the body. During the proceedings S. Towill was thanked for his services as Honorary Secretary for the past four years, and presented with the customary Certificate of Service, and a copy of the book '*The History of the Institution of Electrical Engineers*'.

When the Committee met at Chester on the 14th November, 1960, G. S. Shepherd, the Honorary Secretary, reported that O. C. Waygood, O.B.E., a Past-Chairman, and Honorary Secretary, first of the Sub-Centre, and then of the Centre for many years, had died.

Papers presented to the Centre during the session included one on 'The application of irradiation in industry' by Mr. Crowley-Milling; a lecture on 'Teaching and learning machines' by E. G. Bailey; 'Thermistors—their theory, manufacture and application' by Dr. R. W. A. Scarr and R. A. Setterington; and a lecture by W. J. Bray on 'The potentialities of artificial earth satellites for radio communication'. Other new developments were brought to the attention of members of the Centre when Prof. J. C. West delivered a lecture on 'Cybernetics', and U. G. W. Knight read his paper on 'The logical design of electrical networks using linear programming methods'.



'The application of electronics to the electricity supply industry' by Dr. J. S. Forrest, and 'Magnetohydrodynamic generation of electricity' by Dr. P. L. Davies and Dr. D. J. Harris, were also read at Centre meetings.

When the Committee met in July they were very sorry to learn of the death of B. Welbourn, a founder member of the Centre, a Past Vice-President of the Institution, who had served as Chairman of the Mersey & North Wales Centre on two occasions.

1961-62

At the Ordinary Meeting held on the 2nd October 1961, R. N. Pegg delivered his Chairman's Address entitled 'For the record'. In the same month, a meeting was held in the Chadwick Laboratory, at the University, when B. S. Halliday read a paper on the 12 MeV Van de Graaff Accelerator that had recently been installed. At the conclusion of the talk members examined the machine in the laboratory.

Discussions took place at this time between the Chairman and Honorary Secretary of the Centre with their opposite numbers in the Institution of Civil Engineers and the Institution of Mechanical Engineers on the possibility of holding one Joint Meeting annually. This would replace the various joint meetings that were then being held. Agreement was reached on the proposal and that the lectures should be known as 'The Annual Joint Lectures of the Chartered Engineers (The Institutions of Civil, Mechanical, and Electrical Engineers, Mersey & North Wales).

The Committee met again in January 1962, when L. H. Cullingford, a member of headquarters' staff, attended to advise members on the new Divisional structure which, for the Institution as a whole, would come into operation in October 1963. When applied to local Centres, the equivalent of Divisions would be known as Sections. Each Section would have its own Officers and Committee. The view was taken that the new Sections would create more opportunities for members to take an active part in the work of the local Centre. Mr. Cullingford also reported that the number of members of the Mersey & North Wales Centre registered with the existing specialised Sections at

Headquarters was as follows:

Measurement and Control Section	103
Radio & Telecommunications Section	140
Supply Section	179
Utilisation Section	177

The Committee agreed in principle that the Mersey & North Wales Centre should adopt a Sectional Structure on similar lines to those adopted in London. It was also agreed to hold a postal ballot so that members could signify their agreement or otherwise.

At this time the Committee expressed their appreciation of the services rendered by W. W. Kenyon who, after serving the Centre as Projectionist for 40 years, had recently requested to be relieved of this duty.

Meetings held during the session provided members with a varied programme of technical papers which included: 'The electrical requirements of general cargo docks' by E. R. Radway; 'Transistors' by P. Godfrey; 'The place of formal study in Postgraduate training of an electrical engineer' by N. N. Hancock and P. L. Taylor, and 'The education of electrical engineers' by Prof. M. R. Gavin. Papers read during the second half of the session included: 'Electronics in the supply industry' by Dr. J. S. Forrest; and 'Better opportunities in technical education' by H. W. French, of the Inspectorate of the Ministry of Education (now the Department of Education & Science), based on a Government White Paper (Cmnd. 1254, HMSO), under that title and recently published.

The Faraday Lecture was again held at the Philharmonic Hall. It was delivered on the 1st March 1962, by D. A. Barron, M.Sc., (M), and entitled 'Expanding horizons in communications'. Performances were given in the morning and in the evening.

At the Annual General Meeting held on the 2nd April 1962, a presentation was made to W. Parry upon his retirement, in the form of an autochange record player, subscribed by members of the Centre. In making the presentation, the Chairman spoke of Mr. Parry's long record of service to the Centre. Following the business meeting, J. Collins introduced a discussion on the new structure which had been devised by the Institution. In particular, it was felt at the Centre that it would provide a greater opportunity for people engaged in the electronics field to hold meetings of a specialized character. It was



pointed out that the Council of the Institution felt that times were changing and that the Institution should be prepared to make changes to meet them.

During the session, J. B. Peacock died. He was a past Vice-Chairman and member of the Centre Committee. He had taken a keen interest in the qualifications of electricians engaged in sea-going service.

#### SUMMER MEETING IN MERSEY & NORTH WALES CENTRE

For the first and only time since the formation of the Centre in 1923, up to its Jubilee in 1973, a Summer Meeting of the Institution was held from the 18th to the 22nd June 1962, at the invitation of the Chairman and Committee of the Centre. However, the Institution did hold a Summer Meeting in the North-West in 1923. On that occasion part of the time was spent in the North-Western Centre, and part in the Mersey & North Wales (Liverpool) Centre. As Mr. L. H. A. Carr wrote, in his *History of the North-Western Centre*, it was 'a happy choice that allowed the Institution as a whole to visit the Mersey Centre during the first year of its independent existence'.<sup>2</sup>

Some 320 members and their ladies attended including the President, Mr. G. S. C. Lucas, O.B.E., F.C.G.I., and Mrs. Lucas, and the Secretary of the Institution Mr. W. K. Brasher, C.B.E., M.A., and Mrs. Brasher. During the meeting the headquarters were at the Adelphi Hotel, Liverpool. A number of visits, excursions and functions was arranged, which commenced with a civic reception and dance, when members and their ladies were received by the Lord Mayor of Liverpool and the Lady Mayoress at the Town Hall. On another evening a cruise of the River Mersey was arranged on board the mv *Royal Iris*, with dancing and refreshments, as guests of the Merseyside & North Wales Electricity Board. A dinner-dance was held in the Banqueting Suite of the Adelphi Hotel, when the President presided, supported by the Chairman of the Centre, R. N. Pegg. On the final evening a Buffet Supper Dance was organized, also at the Adelphi Hotel. A large number of companies and other bodies extended invitations to those attending the Summer Meeting to visit their establishments.

W. K. Brasher, who had been Secretary of the Institution since 1939, retired in 1962. Dr. G. F. Gainsborough, B.Sc., Ph.D., a

corporate member of the Institution succeeded him. He was also a Barrister-at-Law of Gray's Inn. He had presented a number of papers to the Institution, and, in 1948, was awarded the Ambrose Fleming Premium.<sup>3</sup>

#### 1962-63

The Officers elected to serve during the 1962-63 Session were J. A. Mason, C.B.E., Chairman; Dr. M. Cowan, Junior Vice-Chairman; G. Shepherd, Honorary Secretary; S. Towill, Honorary Treasurer; C. E. R. Fairburn and B. F. Tickle, Hon. Assistant Secretaries; D. A. Picken, Local Honorary Treasurer of the Benevolent Fund; and E. W. Ashby, Honorary Editor. However, Mr. Picken resigned and G. L. Simpson was appointed in his place.

The first Committee Meeting, held in October 1962, was attended by B. Donkin, a Vice-President of the Institution, who gave a short address on the new divisional structure. An Ordinary Meeting followed, which was also attended by Mr. Donkin who took the chair. He invited Mr. Mason to deliver his Chairman's Address, an authoritative review entitled 'Automatic telephony in my time—1911-1961'.<sup>4</sup> The author stated that during the period he was discussing, the world's telephones had grown from 10 million, few of which were automatic in action, to some 142 million, of which about 90% were automatic. The majority of these used the Strowger step-by-step principle of operation, the British Standard. Mr. Mason mentioned the U.S.A., Germany, Belgium, the U.K., Sweden and France as the principal countries concerned with the development of the automatic telephone. His discourse included a description of various forms of apparatus and mountings; switching systems and their historical development, and important changes by decades. In concluding his address the author mentioned the trial electronic exchanges in the United States and the UK, and suggested that they pointed the way to future developments. Fig. 51 shows a modern Strowger automatic telephone exchange, and Figs. 52 and 53 show a modern reed relay-switching unit and a crossbar switch shelf, respectively.

When the Committee met in December, the members were informed of the death of Prof. Marchant on the 14th November. Throughout



his career he had taken a very active part in the work of the Institution. He was a Past-President; from 1914 to 1916 he was Chairman of the North-Western Centre; the first Chairman of the Liverpool Sub-Centre, and Chairman of the Mersey & North Wales (Liverpool) Centre during 1929-30. He was Emeritus Professor of Electrical Engineering at Liverpool University.

During the business conducted at the March Committee Meeting it was decided to apply for the Council's permission to form an Electronics Section and a Power Section at the Centre. At its April meeting the Committee were informed that the Council had agreed to the setting up of the two Sections.

The programme for the session included papers on 'Large steerable microwave aerials for communication with artificial Earth satellites and space probes' by F. J. D. Taylor, O.B.E., B.Sc.(Eng.); 'The BBC Television Centre and its Technical facilities' by F. C. McLean, C.B.E., B.Sc., H. W. Baker, O.B.E., and C. H. Colborn, B.Sc.; 'Recent research in thermionics' by G. H. Metson, M.C., D.Sc., M.Sc., Ph.D., B.Sc.(Eng.); and 'Optical masers' by I. L. Davies. In the absence of the Faraday Lecture, the Committee arranged a special lecture for school children during the Easter holidays. The lecture entitled 'Propulsion without wheels' was given by Dr. E. R. Laithwaite.

1963-64

The new session commenced with programmes arranged for the two specialised Sections and the second full year of the Education & Training Circle, which had made a promising start in the previous session. The new Chairman was Dr. W. J. J. Curry, Ph.D., B.Sc., and his Chairman's Address was delivered in Liverpool and repeated at a District Meeting in Warrington. It was entitled 'The electrical engineer in industry'. Dr. Curry had to retire from the Chair before the session ended and Dr. J. M. Cowan took office for the remainder of the session. Prof. M. R. Gavin had been elected Vice-Chairman, but withdrew from the Committee for health reasons. D. M. MacLaren was co-opted to take his place.

The papers read at meetings during the first half of the session

included: 'A.C. railway electrification' by J. K. Lord; 'The trusteeship of electric power' by F. C. Walmsley, the Power Section Chairman's Address; 'Some research in electrical breakdown in liquids' by J. B. Higham, Ph.D., B.Sc., the Electronics Section Chairman's Address; 'The influence of electrical engineering (Developments) on management' by G. R. Harding, T.D., B.A.; 'Development of the Atlas Computer' by D. B. G. Edwards, Ph.D., M.Sc.; and 'Control and safety requirements for the electrical engineering system of the CEGB nuclear power stations' by H. M. Gott, M.A., and R. D. Trotter, B.Sc.(Eng.).

During the second half of the session Prof. M. G. Say, Ph.D., M.Sc., gave a lecture on 'An engineer in Moscow'. The Faraday Lecture was delivered by J. S. Forrest, M.A., D.Sc., on the subject of 'Making electricity' in March 1964, when two performances were given.

#### FERRANTI CENTENARY

The year 1964 was the centenary of Dr. Sebastian Z. de Ferranti, a leading pioneer of electrical engineering, who was born at 130 Bold Street, Liverpool, on the 9th April 1864. A Centenary Commemorative Lecture was organized by the Mersey & North Wales Centre and the North-Western Centre of the Institution of Electrical Engineers. It was given by A. R. Cooper, M.Eng., M.Inst.F., (M), of the Central Electricity Generating Board, on the 7th April at Liverpool, and on the 9th April in the Renold Building of the Manchester College of Science & Technology.<sup>5</sup>

Through the courtesy of the Lord Mayor of Liverpool, Alderman J. McMillan, the lecture organized by the local Centre was delivered in the Council Chamber of the Town Hall. J. Mason, the immediate Past-Chairman of the Mersey & North Wales Centre presided. In thanking the lecturer, Sir Vincent de Ferranti expressed the appreciation of his family to the Institution of Electrical Engineers for holding the commemorative lectures. At the conclusion of the proceedings the Mersey & North Wales Centre Committee entertained the following special guests at an informal dinner at the Exchange Hotel, Liverpool: Sir Vincent and Lady de Ferranti; Mr. and Mrs. Denis de Ferranti; Nigel de Ferranti; Mark de Ferranti; Madame de Latour,



cousin of Sir Vincent de Ferranti; the Town Clerk of Liverpool T. Alker and Mrs. Alker; the Principal of the Liverpool Regional College of Technology, Mr. S. A. J. Parsons and Mrs. Parsons; the President of the Liverpool Engineering Society Mr. N. H. Stockley; the Chairman of the Institution of Electronic & Radio Engineers, A. E. Mews and Mrs. Mews; the Chairman of the Liverpool Chamber of Commerce J. N. M. Holt and Mrs. Holt; and the Deputy-Chairman of the Merseyside & North Wales Electricity Board, D. G. Gwyn.

Sebastian Ziani de Ferranti, D.Sc., F.R.S., died at Zurich on the 13th January 1930.<sup>6</sup> His father, César de Ferranti, had a photographic art studio in Bold Street, Liverpool. He married Madame Julie Szczepanowski, widow of Count Szczepanowski. She was formerly Miss Juliana Scott, daughter of the portrait painter William Scott. The marriage took place on the 4th November 1860, at St. George's Church, Liverpool. Their son Sebastian was born to be an engineer. His earliest impressions were gained at Lime Street Station where he was taken by his nurse to look at the locomotives. He left Liverpool when he was eight years old, and went to Belgium with his sister Juliet to learn French. On returning to England he went to school at Hampstead, and later attended St. Augustine's College, Ramsgate. When his father wrote to him in December 1877, to say that he was considering having electric lighting installed in the house in Bold Street, young Sebastian supported the idea enthusiastically.

Scientifically Ferranti was self-taught, but he attended evening classes at University College, London. In 1881 he sold a small dynamo he had constructed for £5 10s. Fig. 54 is a reproduction of an original sketch made by his half-sister Wanda Szczepanowski, showing Ferranti making his dynamo<sup>7</sup> at the age of 16. He joined Siemens Brothers but remained with them for only a short time. In 1882 he went into partnership with Alfred Thomson (with whom he took out his first patent) and Mr. Francis Ince, a lawyer, and was appointed engineer to the company. He was 18 years old. The aim of the partnership was to exploit the 'Ferranti dynamo'. and the project at once became successful commercially. Unfortunately, another company, which had acquired the selling rights, ran into financial difficulties, and both companies went into voluntary liquidation. Ferranti bought back his patents, and, in 1883, commenced business on his own account.

This brought him into contact with the Grosvenor Gallery Co. which had begun to experience difficulties in providing a system of electric lighting. Ferranti was approached and this led to his appointment as engineer to the company at the age of 22. Although he improved and enlarged the system, the demand grew faster, and he began to plan a much larger scheme. He obtained the support of the Grosvenor Gallery directors, who formed the London Electric Supply Corporation in 1887.

Ferranti soon became deeply involved in planning the new Central Station at Deptford, where he introduced the modern concept of electrical power generation. Fig. 55 shows Ferranti at the age of 24, when he was engaged on this pioneer project. The station commenced to supply electricity in November 1890, and in the following year, when it was running satisfactorily, Ferranti left to concentrate on his manufacturing business. His interests were much wider than electrical engineering, and embraced, for example, mechanical engineering, the design and manufacture of textile machinery, and instrumentation.

In 1896, the works were moved from London to Hollinwood, near Manchester, where, during the First World War, they were converted into a munitions factory, and Ferranti both supervised and controlled production. When hostilities ceased the company reverted to its electrical engineering interests.

In 1912, the University of Manchester conferred on Ferranti the honorary degree of Doctor of Science, and, in 1927, he was elected a Fellow of the Royal Society.

Dr. Ferranti maintained his interest in Liverpool, visiting the city on many occasions. During a visit in 1891, in a letter to his wife, he wrote:

'As Mass was over by about midday I went for a walk to the landing stage and had a look at the river and the ships but it was too foggy on the water to see much.

It seems so very strange to go quietly over all the old places again. They have changed very little. It seems a sort of dream to see them all again'.<sup>8</sup>

Dr. Ferranti joined the Institution of Electrical Engineers as a Member (old style) in 1891. He became a Member of Council in 1895, and served as President of the Institution during 1910 and 1911. In 1924 he was awarded the Faraday Medal. In the following year he



was elected an Honorary Member. It is also relevant to recall that he was elected a Member of the Liverpool Engineering Society in 1900.

Ferranti was essentially an engineer and inventor. Although he became the head of a large and progressive family business, technical matters were never far from his thoughts. His two greatest achievements have been described as the production and transmission of electrical energy at high pressure and its distribution at low pressure, and the great aim of his life to make the use of electricity universal. Only a brief visit to the Ferranti Archives at Hollinwood is sufficient to make one appreciate the genius of this extraordinary man, and his outstanding contribution to the development of electrical and other branches of engineering.

Fig. 56 shows one of the Ferranti flywheel generators installed at Southport in 1895, and Fig. 57 a Ferranti 200 kW alternator installed at Wallasey in 1899.

#### 1964-65

The Officers appointed for the 1964-65 Session were Dr. J. M. Cowan, Dr.-Ing, B.Sc., Chairman; D. M. MacLaren and E. Jacks, Vice-Chairmen; B. F. Tickle, Honorary Secretary; S. Towill, B.Sc.(Eng.), Honorary Treasurer; J. Fisher, Honorary Assistant Secretary; and G. L. Simpson, B.Sc.(Eng.), Honorary Treasurer, Benevolent Fund.

An extensive programme of meetings was arranged, which commenced with the Chairman's Address entitled 'The annihilation of a problem', and included a number of interest to the specialist sections. In January 1965, S. Towill presented a paper on 'The Swedish electricity supply system', at a District Meeting held at Oswestry.<sup>9</sup> He had paid a study visit to the Sydsvenska Kraftakiebelaget, which was the largest private power company in the country. It catered for an area of approximately 14 000 square miles with a population of 1.5 million. Electrical power was provided to about 99% of the inhabitants.

This session saw the introduction of the 'Silvanus P. Thomson Lecture' which replaced the Graduate & Student Lecture delivered annually. It was given the status of a 'named' lecture. The first

Sylvanus P. Thomson Lecture to be delivered in Liverpool was entitled 'Satellite Communication' by D. Wray, on the 22nd February 1965, to an audience of 203 Graduates, Students and visitors.

On the 3rd August 1965, a Charter of Incorporation was granted to the Council of Engineering Institutions, previously known as the Engineering Institutions Joint Council.

#### 1965-66

Because of alterations being undertaken at the Royal Institution, Colquitt Street, arrangements were made for Centre Committee and Ordinary Meetings to be held at the Electrical Engineering Laboratories at the University of Liverpool, when the venue was Liverpool.

D. N. MacLaren became Chairman for the session and was supported by E. Jacks and F. C. Walmsley as Vice-Chairmen. The Chairman's Address was entitled 'Electrical safety on heavy current electrolytic cell systems'. The Faraday Lecture was given in Liverpool by P. D. Hall, B.Sc., (M), whose subject was 'Computers, automation and control'. At a District Meeting in the Isle of Man in April 1966, R. N. Pegg gave a lecture entitled 'An impression of electricity supply and energy demands in the USA and Canada'.

#### 1966-67

E. Jacks took the Chair for the 1966-67 Session, with F. C. Walmsley and Prof. F. J. Hyde, D.Sc., as Vice-Chairmen; G. W. Launder, M.A., became an Honorary Assistant Secretary. The Chairman's Address entitled 'Standards of quality and reliability relating to fuses', was given on the 3rd October, 1966. In December, B. S. Keeling, of the National Economic Development Council, spoke on 'Improving national economic performance—the role of the electrical Engineer.'

At the meeting held on the 9th January 1967, members of kindred societies and organisations, including R. Weills, French Commercial Attaché, Manchester; G. Stebbings, BEAMA; D. C. Dodds, Chairman, MANWEB; and the French Consul General J. D. P. Legrain, and Madame Legrain, attended to hear Rene Sergent of the Syndicat Général de la Construction Electrique, give a talk on 'Current



economic problems in Europe'. Dr. M. R. Barrault proposed the Vote of Thanks to the speaker in French, which was greatly appreciated by both the lecturer and the French representatives present.

The Faraday Lecture was again given in the afternoon and the evening, on the 2nd February, 1967. The lecture on 'Nuclear power, today and tomorrow' was delivered by R. V. Moore, G.C., C.B.E., B.Sc.(Eng.), M.I.Mech.E., (M), of the United Kingdom Atomic Energy Authority.

The Centre Summer Meeting this year was given a 'new look'. It took the form of a garden party held in the grounds of Ruthin Castle, North Wales, on a perfect June day. Some 254 Members and their Ladies were entertained in very delightful surroundings.

#### 1967-68

The Chairman for the new session was Prof. F. J. Hyde, D.Sc., F.Inst.P., M.I.R.E., (F), with C. C. Smith and E. F. Duncan as Vice-Chairmen. S. Towill continued to act as Honorary Treasurer, and G. W. Launder became Honorary Secretary, with C. Kowe as Honorary Assistant Secretary. B. Tickle relinquished the Honorary Secretaryship to become the Honorary Secretary of the local CEI Committee.

The Chairman's Address on 'Thermistors' was given on the 2nd October, 1967.<sup>10</sup> Prof. Hyde considered the production of thermistors (thermally sensitive resistors) in the 1930s and early 1940s, and their later development. He then considered the basic thermistor equations, and outlined five different classes of applications of directly heated thermistors. In conclusion, he examined thermistor geometrics to suit particular applications.

During the meeting the Chairman expressed the thanks of the Centre to B. Tickle for the services he had rendered as Honorary Secretary and Honorary Assistant Secretary over a period of seven years. He then welcomed G. W. Launder as the new Honorary Secretary.

Papers presented during the session included 'The Effect of natural gas supplies on the economy of the electrical supply and manufacturing Industries' by Mr. C. E. R. Fairburn, Chairman of the Power Section; 'Tidal power stations—La Rance and afterwards' by Dr. E. M. Wilson;

'Battery Electric Vehicle' by B. S. Hender; and 'Electrical traction in the railway of the future' by J. A. Broughall. In addition to the normal programme of meetings an *ad hoc* meeting on a specialized subject was arranged in April, 1968, at Ellesmere Port. A discussion was held on the 'Control of static electricity in pipelines carrying flammable liquids', and 'Protection against lightning discharges on structures in which flammable materials are processed'.

No Faraday Lecture was provided in the Centre during the session and, as a result, the Centre Committee arranged a lecture for schools during the Easter vacation. Dr. P. E. Secker gave a talk on the 'Electrostatic generation of electricity' at the University of Liverpool, which was attended by 270 children accompanied by their teachers.

This session was one of consolidation, following proposals which were being implemented, to reorganize the Centre. These changes included modifications to the boundaries between the North-Western Centre and the Mersey & North Wales Centre.

At a Special Centre Meeting held in the Town Hall, Chester, the Chairman explained:

'... that new regulations for local Centres issued by the Institution in 1967 required that voting for Committee Members in future years should be by the single transferable vote system. However, subject to prior approval by a majority of the members entitled to vote at a meeting of the Centre convened for that purpose the present method of election could continue to be employed'.

The title 'Fellow' was introduced at this time. The new class of Fellow replaced the former class of Member, and the new class of Member replaced the former class of Associate Member. These changes were made at the request of the Privy Council, following the setting up of the CEI, and the resultant registration of Chartered Engineers. Primarily the changes followed from alterations to the Institution's Charter, and the desirability of reducing the proliferation of qualifications and their designatory letters. For example, Graduates of the Institution would no longer be entitled to employ the designatory letters Grad.I.E.E.

#### 1968-69

For the third time since the formation of the Centre, a Past-Chairman



was elected President of the Institution of Electrical Engineers. On this occasion it was Prof. J. M. Meek, D.Eng., F.Inst.P., (F), whose portrait is reproduced in Fig. 58, who had been a staunch supporter of the Centre for many years. He was born in Wallasey, Cheshire, and received his education at Kingsmead School, Hoylake, and Monkton Coombe School, Bath. In 1931 he was awarded a Bartlett Scholarship to the University of Liverpool, where he studied under Prof. E. W. Marchant (the first of the Centre Past-Chairmen to become Presidents of the Institution) in the Department of Electrical Engineering. As a matter of interest Prof. Marchant was President in 1932, when Mr. Meek, the undergraduate, joined the Institution as a Student. He graduated with first-class honours in electrical engineering in 1934, and was awarded both the William Rathbone Medal and the David Inglis Dawbarn Prize. The former is awarded to a candidate who has specially distinguished himself in the examination for the degree of Bachelor of Engineering with Honours.<sup>11</sup> Mr. Meek then joined the Metropolitan-Vickers Co. as a college apprentice. On the completion of his apprenticeship, he became a member of staff and entered the company's high-voltage research laboratory, where he worked under the direction of Dr. T. E. Allibone on studies relating to high-voltage spark breakdown. This work set the course for his career which led him to concentrate on research associated with electrical discharges in gases.

In 1938, Mr. Meek was awarded a Commonwealth Fund Fellowship, and the next two years were spent in the Department of Physics at the University of California, Berkeley, Calif. U.S.A. During this period he was concerned mainly with the theoretical studies of the spark mechanism and, in association with Prof. L. B. Lock, was responsible for the development of the streamer theory of the spark. Mr. Meek returned to the U.K. in 1940 and resumed his duties with Metropolitan-Vickers. During the Second World War he undertook research concerned with radar equipment. Jointly with Prof. J. D. Craggs and Dr. M. E. Hame, he was responsible for the development of triggered spark gaps, for use in high power modulators and, in particular, for the invention of the trigatron.

In 1942, Mr. Meek was awarded the degree of Doctor of Engineering by the University of Liverpool. In the same year, he received an Institution Premium for his paper on 'The electric spark in air'. Four

years later Dr. Meek accepted an appointment to the David Jardine Chair of Electrical Engineering (Electronics) at the University of Liverpool.

Prof. Meek continued his investigations on spark breakdown and, as a result of the collaboration between himself and his colleagues Prof. J. D. Craggs, Prof. H. Edels, and Prof. J. H. Leck, built up a research school on electrical discharges in gases which enjoys an international reputation. In 1952, following a reorganization within the department, he became Professor of Electric Power Engineering.

Prof. Meek is a fellow of the Institute of Physics, and a Member of the American Institute of Physics. These associations reflect the extent of his interests, which lie beyond the boundaries of engineering, and many of his published papers have appeared in various physics journals. In 1969 he was appointed a member of the Independent Television Authority until 1974. In 1970, during a visit to Japan as a guest of the Japanese Institution of Electrical Engineers he was elected an Honorary Fellow of that Institution.

Professor Meek was elected an Associate Member (old style) in 1942. In 1953 he was transferred to the class of Member (old style) of the Institution of Electrical Engineers, and from 1945 to 1948, and again from 1960 to 1963, served as a Member of Council. He was Chairman of the Mersey & North Wales Centre during the 1952-53 Session. In 1964 he was elected a Vice-President, and in 1968 became President of the Institution of Electrical Engineers.<sup>12</sup> Many electrical engineers and members of other organisations know him as an extremely able, and humorous, after dinner speaker.

In his Inaugural Address<sup>13</sup> entitled 'The vital spark', delivered before the Institution of Electrical Engineers in London in October 1968, Prof. Meek explained that the subject of spark breakdown in gases had been his main research interest for many years. His researches were first undertaken in industry and subsequently in the university. He then proceeded to 'outline some of the observed mechanism of growth of spark discharges ranging from lightning down to the short spark produced in the laboratory under controlled conditions'. Following his extremely interesting survey of spark discharges, he discussed the research work undertaken in universities on spark breakdown. He mentioned the 'substantial contributions by university engineers to engineering publications'. For example, an analysis of the *Proceedings*



of the *Institution of Electrical Engineers* showed that during the years 1966 and 1967 the total number of papers published was 490, of which 212 (or 43%) came from British university laboratories. Similarly, an analysis of *Electronics Letters* for 1966–67 showed that 63% of the British contributions were from universities.

The Centre Officers elected to serve for 1968–69 were E. F. Duncan, Chairman; S. Towill, Vice-Chairman; D. H. C. McAuslan, Vice-Chairman; G. W. Launder continued as Honorary Secretary, and S. Towill, as Honorary Treasurer. In addition, N. Clarke was appointed Honorary Assistant Treasurer; and M. Hilton and M. B. Olver, became Honorary Assistant Secretaries.

Mr. Duncan, a member of the BICC Accessories Division, Prescot, gave the Chairman's Address on the 7th October, 1968, and his topic was 'The engineer'.<sup>14</sup> He stressed the importance of cost—the minimum cost for a given level of reliability. He argued that a specification might be right and proper when it was introduced, but its purpose changed over the years and, as a result, all specifications should be re-examined 'first for the validity of the original purposes and secondly, for the availability of new materials which might achieve the same reliability in a less costly fashion'. Mr. Duncan gave an interesting commentary on the function of committees and compared the ways committees worked in this country with those in other countries. In particular, he examined committees working on British Standards, and the Wiring Regulations Committee, pointing out possible drawbacks. He suggested that young engineers must be granted greater authority.

To the regret of his colleagues Mr. Duncan had to resign as chairman, owing to ill health, and S. Towill, the Senior Vice-Chairman, took over his duties. During the session the programme of meetings was based on a common theme under the heading 'Local distribution and installation', which met with considerable success. The Faraday Lecture dealt with 'Microelectronics' and was delivered by P. E. Trier, M.A., F.I.E.R.E., F.I.M.A., (F), of Mullard Ltd. The usual two performances were given.

1969–70

S. Towill continued in the chair for the new session and D. H. C.

McAuslan, B.Sc., and C. E. R. Fairburn, M.A., were elected Vice-Chairmen. H. Currie, M.Eng., became Honorary Secretary, with N. Clarke as Honorary Treasurer. The Honorary Assistant Secretaries were M. Hilton and B. W. Alcock.

When Mr. Towill was formally introduced to the office of Chairman, E. Jacks, in the absence of E. F. Duncan, 'recounted the long period that Mr. Towill had given to the Centre, which include the Offices of Honorary Secretary, Honorary Treasurer, Committee Member, and Vice-Chairman, from 1950 continuously'. He said this was a commendable record of dedicated service to the Centre, and that 'we were fortunate indeed to have Mr. Towill as our Chairman for this coming session'. Mr. Towill's Chairman's Address was entitled 'Logic and the engineer'.

The Faraday Lecture by Prof. J. H. H. Merriman, C.B.E., was given on three occasions. It proved immensely popular and dealt with 'People, communications and engineering'.

In the Annual Report for the session, the Chairman singled out two objectives which he considered were of particular importance. The first aim was 'to obtain a high level of the personal involvement of the members in the affairs of the Centre'. The second aim was 'to make a distinctive individual Centre contribution to the work of the Institution'. The first objective was being achieved by introducing changes in the work of the Centre Committee, e.g., by appointing small working parties to deal with specific topics. The second objective was being dealt with by utilizing local talent. All the papers read during the session had been specially commissioned for the Centre. The papers concerned with the environment had been collected together and published very successfully under the title 'The engineer and the environment'.

In 1970 the total membership of the Centre had increased to 1917, comprising 156 Fellows, 765 Members, three Companions, 46 Associates (former class), 686 Associate Members, 65 Associates (new class), and 194 Students.

1970–71

D. H. C. McAuslan, B.Sc., was elected Chairman for the new session. The Vice-Chairmen were C. E. R. Fairburn, M.A., and



D. G. Gwyn, B.Sc., with H. Currie, M.Eng., continuing as Honorary Secretary, and M. Hilton and B. W. Alcock as Honorary Assistant Secretaries. N. Clarke again served as Honorary Treasurer. McAuslan's Chairman's Address dealt with 'Engineering and Management'.

In January 1970, the Centre Committee was informed that S. Towill had accepted the appointment of Vice-Chairman of the local C.E.I. Committee for the current session, with a view to becoming Chairman next session.

In February, the Honorary Secretary reported that W. W. Kenyon, Chief Technician in the Electrical Engineering Department of the University of Liverpool had recently been awarded the Honorary Degree of Master of Engineering by that University. He had completed more than 50 years' service, and would shortly be retiring. He had provided various services to the Centre for over 30 years. The Honorary Secretary wrote to Mr. Kenyon on behalf of the Centre Committee offering him its congratulations.

The Faraday Lecture was delivered by S. Z. de Ferranti, whose subject was 'Changes and the future in electrical engineering'.

Mr. Towill attended a Council Meeting on the 2nd April 1971, which was held in Birmingham, the first meeting of its kind to be held outside London.

A dinner was held during the year, and an exhibition successfully organized, to celebrate the Centenary of the Institution's foundation.

At the Committee Meeting arranged in July, Mr. Towill reported on the satisfactory sales of the publication entitled 'The engineer and the environment'. He suggested that money which would be allocated to the Centre as a result of this venture should be used to promote a research project into the historical development of scientific and engineering societies in the Liverpool area. This was agreed, and a working part was set up to make the necessary arrangements. This publication was produced as a result.

#### 1971-72

C. E. R. Fairburn, M.A., took the Chair for the 1971-72 Session, supported by D. G. Gwyn, B.Sc., and J. C. Ireland, M.B.E., B.Sc., as Vice-Chairmen. The remaining Officers continued to serve.

At the Ordinary Meeting held in October 1971, Mr. McAuslan presented W. W. Kenyon with a copy of 'The history of the I.E.E.', and a cheque, in appreciation of his long association with Centre activities, and wished him well on his retirement from the University of Liverpool. Mr. Fairburn then delivered his Chairman's Address on 'The engineer in society'.

This year's Faraday Lecture was given at the Philharmonic Hall by Dr. Sydney Jones, of British Rail, whose subject was 'Electricity on rails'.

#### 1972-73

Mr. D. G. Gwyn, O.B.E., B.Sc., was elected Centre Chairman for the Jubilee year, with J. C. Ireland, M.B.E., B.Sc., and R. D. Haigh, M.Eng., as Vice-Chairmen. D. B. McRobert became Honorary Secretary, and N. Clarke continued to act as Honorary Treasurer. The Honorary Assistant Secretaries were H. Currie, M.Eng., and B. Nield. The Chairman's Address, given in October 1972, was entitled 'The management of an area Electricity Board'.

At the Ladies Evening held on the 5th February 1973, the present writer gave the Centre Jubilee Lecture, entitled 'The history of the Mersey & North Wales Centre', at the University of Liverpool. In March, Dr. A. Stratton delivered the Faraday Lecture on 'Navigating—Land, Sea, Air and Space' at the usual venue.

The survey that has been made of the foundation, development and growth of the Mersey & North Wales Centre of the Institution of Electrical Engineers shows, first, that many accomplished and distinguished electrical engineers have served and continue to serve the Centre, Merseyside and the nation, since its inception. Secondly, the learned society activities have been maintained at a high level throughout the period. The Centre, through the work of its growing number of members, has made a valuable and sustained contribution to the life of the community on Merseyside, of which it may be truly proud.



## REFERENCES AND NOTES

## ABBREVIATIONS

*Trans. LES*: Transactions of the Liverpool Engineering Society

*Jnl. LES*: Journal of the Liverpool Engineering Society

*Jnl. IEE*: Journal of the Institution of Electrical Engineers

*J. IEE*: Journal of the Institution of Electrical Engineers (New Series)

*Proc. IEE*: Proceedings of the Institution of Electrical Engineers

*DNB*: Dictionary of National Biography

## CHAPTER 1

- 1 DODD, A. H.: 'The industrial revolution in North Wales'. (University of Wales Press, 1971, 3rd edn.)
- 2 *Trans. LES*, 4th March 1915
- 3 ROLT, L. T. C.: 'The story of the second Mersey tunnel and approach roads'. Mersey Tunnel Joint Committee, 1971
- 4 *Trans. LES*, XXXVII, 42nd Session, 1916, pp. 56-73
- 5 *Op. cit.*, 1899, XX, 25th Session, p. 10
- 6 'The Liverpool Overhead Railway—A pioneer in rapid transport', *Trans. LES*, 1952, LXXIII, 78th Session, pp. 89-112
- 7 Addresses included those given by John A. Brodie in 1895, J. Reginald Taylor in 1899, and Ernest S. Wilcox in 1902, published in the *Transactions*. For later developments a paper entitled 'Tramways' by Thomas Molyneux, M.B.E., M.I.Mech.E., published in Vol. XLV of the *Transactions*, may be consulted
- 8 There is a selection of unpublished material; the primary source is the collection of published annual reports of the general manager, Liverpool Corporation Tramways & Omnibuses
- 9 In the book 'The golden age of tramways' by Charles Klapper (Routledge & Kegan Paul, 1961), the author states that the first tramway was opened in Liverpool in 1859. This was a passenger service utilising the rail system employed for goods traffic owned by the Mersey Docks & Harbour Board, running largely on dock roads, using horse-drawn trams. The service caused inconvenience to dock freight traffic, and the scheme was withdrawn after nine months. The Birkenhead project was planned and undertaken on public roads. The dock tramway is also referred to in 'Tramway companies in Liverpool, 1859-97' by S. Alasdair Munro, published in the *Trans. Hist. Soc. of Lancashire and Cheshire*, 119, 1967, p. 181
- 10 *Trans. LES*, 1909-10, XXXI, pp. 441-442
- 11 *Liverpool Official Handbook*
- 12 BROOKS, COLIN: 'Graysons of Liverpool': a history of Grayson, Rollo and Clover Docks Ltd. (Henry Young, Liverpool, 1956)
- 13 'Mersey Shipbuilding and Ship-repairing', *Manchester Guardian, Liverpool: Commercial Supplement*, 14th July 1927, p. 17

- 13 FLETCHER, GARDNER C.: 'The growth of marine engineering at Birkenhead during the last 100 years and possible developments in the immediate future', *Jnl. LES* 1960-61, VI, pp. 127-65
- 14 *Ibid.*, pp. 67-92
- 15 SWALE, W. E.: 'Forerunners of the North-Western Electricity Board', (The North-Western Electricity Board, Manchester) provides a useful summary
- 16 *Ibid.*
- 17 'City & County of the City of Chester Electricity Undertaking: Jubilee Commemoration 1896-1946', on which these notes are based
- 18 *Ibid.*, p. 30

## CHAPTER 2

- 1 STEPHENS, M. D., and RODERICK, G. W.: 'Education and training for English engineers in the late 19th century and early 20th century', *Annals of Science*, June 1971, 27, (2), includes details of both the Liverpool Polytechnic Society and the Liverpool Engineering Society
- 2 'The Liverpool Philomathic Society', *Illustrated Liverpool News*, August 1966 p. 21, provides a brief historical account of the society
- 3 LEE SYDNEY, (Ed.): *DNB*, 1897, XLIX, 'Celebrities of the century', 1890, 4, pp. 870-871. 'William Roscoe of Liverpool' by G. Chandler, 1953, may also be consulted
- 4 LEE: LVII, 1899
- 5 ORMEROD, H. A.: 'The Liverpool Royal Institution: a record and a retrospect', Liverpool University Press, 1953, is a standard work, on which the author has drawn for the background given of the Royal Institution
- 6 KELLY, T.: 'Adult education in Liverpool', 1960, p. 14. This booklet provides useful guidelines regarding local institutions and their background
- 7 ORMEROD, p. 11
- 8 *Ibid.*
- 9 ROSCOE, W.: 'Discourse delivered on the opening of the Liverpool Royal Institution', 25th November 1817, p. 75. The list of Committee Members is taken from this document
- 10 ORMEROD, p. 27
- 11 'Report of the origin, progress and present state of the Liverpool Apprentices' and Mechanics' Library', by its originator Egerton Smith, *The Kaleidoscope* 1823-24, 4, p. 255
- 12 *Ibid.*
- 13 *The Kaleidoscope*, 1825-26, 6, p. 285
- 14 *The Liverpool Mercury*, 2nd February 1838, published a letter from a member of the Institute, dated 20th January 1838
- 15 STEPHEN, LESLIE (Ed.): *DNB*, 1886, 6
- 16 *The Liverpool Mercury*, *op. cit.*
- 17 *The Kaleidoscope*, 1824-25, 5, pp. 430-431
- 18 TIFFEN, H. J.: 'A history of the Liverpool Institute Schools, 1825-1935' (Liverpool Institute Old Boys' Association, 1935). This publication provides the background to the setting up and activities of the Liverpool Mechanics' Institution
- 19 TYLECOTE, M.: 'The Mechanics' Institutes of Lancashire and Yorkshire before 1851', (Manchester University Press, 1957), p. 9
- 20 TIFFEN, *op. cit.*
- 21 STEWART, D.P.: 'The Woolton Mechanics' Institute', *Trans. Unitarian Hist. Soc.*, 1952, 10. This paper provides a detailed account of the history of the institute, on which the notes given are based
- 22 Prepared from a 'Historical note' published in the 'Union of Lancashire and Cheshire Institutes: One-hundredth Annual Report 1938-39', pp. 111-129



- 23 Obituary notice, *Post & Mercury*, 28th November 1929  
PIKE, W. T. (Ed.): 'Liverpool and Birkenhead in the 20th Century' (1911), biographical note
- 24 'The first page of the history of University College, Liverpool, or the story of its foundation' told by one of the Honorary Secretaries, Dr. J. Campbell Brown, (Marples, Liverpool, 1892)
- 25 Hodder & Stoughton, 1931
- 26 THOMSON, J. J.: 'Recollections and reflections' (Bell & Sons, 1936), p. 409
- 27 'Past years', p. 214
- 28 APPLEYARD, R.: 'The history of the Institution of Electrical Engineers (1871-1931)' (IEE, 1939), p. 293
- 29 *Jnl. LES*, 1962-63, **VII**, obituary notice
- 30 'Opening of Laboratory of Electrotechnics, July 8, 1905' (University of Liverpool Press, 1905)
- 31 A brief description of the new building is given in a booklet entitled 'Electrical engineering and electronics' (University of Liverpool)

## CHAPTER 3

- 1 'The laws and a report of the first two years' Proceedings of the Polytechnic Society, Liverpool' (1841), p. 5
- 2 *Ibid.*
- 3 The quotations which follow are extracted from the *Transactions of the Liverpool Polytechnic Society*, and later the society's *Journal*. The rules and byelaws were often included with annual reports. They appear to have been published finally in 1896
- 4 *Trans. LES*, 1926, **XLVII**, pp. 171-202
- 5 Op. cit., 1881, **I**, p. 49
- 6 *Ibid.*
- 7 *Ibid.* p. 61
- 8 *Ibid.*, p. 32
- 9 *Ibid.*
- 10 *Ibid.*, p. 37
- 11 *Ibid.*, p. 35
- 12 *Ibid.*, p. 36
- 13 *Ibid.*, p. 37
- 14 *Ibid.*, pp. 112-25
- 15 Op. cit., 1881-82, (1883), **III**, pp. 74-82
- 16 Op. cit., 1883, (1884), **IV**, pp. 91-102
- 17 Op. cit., 1885, (1886), **VI**, pp. 54-62
- 18 *Ibid.*, pp. 150-72
- 19 Op. cit., 1887, (1888), **VII**, pp. 43-55
- 20 *Ibid.*, p. 133
- 21 *Ibid.*, p. 134
- 22 Op. cit., 1888, (1889), **IX**, p. 16
- 23 Op. cit., 1889-90, (1890), **XI**, pp. 94-111
- 24 Op. cit., 1890-91, (1891), **XII**, pp. 18-31
- 25 *Ibid.*, pp. 32-42
- 26 Op. cit., 1894, **XV**, pp. 86-94
- 27 Op. cit., 1895, **XVI**, pp. 1-23
- 28 Op. cit., 1896, **XVII**, pp. 113-121
- 29 Op. cit., 1898, **XIX**, pp. 141-143
- 30 Op. cit., 1899, **XX**, p. 8
- 31 Op. cit., 1900, **XXI**, p. 9
- 32 *Ibid.*, pp. 89-113
- 33 *Ibid.*, pp. 149-152

- 34 An interesting account of Marconi's contribution to wireless telegraphy will be found in 'A history of the Marconi Company' by W. J. Baker (Methuen, 1970)
- 35 Op. cit., 1904, **XXV**, pp. 58-68
- 36 *Ibid.*, pp. 74-96
- 37 *Ibid.*, pp. 142-175
- 38 *Ibid.*, pp. 184-203
- 39 Op. cit., 1909, **XXX**, pp. 163-179
- 40 Op. cit., 1914, **XXXV**, pp. 115-128
- 41 Op. cit., 1915, **XXXVI**, pp. 207-224
- 42 Op. cit., 1916, **XXXVII**, pp. 154-172

## CHAPTER 4

- 1 APPLEYARD: pp. 165-167
- 2 CARR, L. H. A.: 'The history of the North-Western Centre of the Institution of Electrical Engineers' (IEE, 1950), p. 20. This publication was reissued in 1968 with an additional chapter by H. G. Bell, covering the years 1950-67. The work includes a short history of the Northern Society of Electrical Engineers
- 3 *Ibid.*, p. 11
- 4 'The Proceedings of the Northern Society of Electrical Engineers', available in the IEE Library
- 5 *Jnl. IEE*, 1919, **57**, p. 338
- 6 CARR: p. 46
- 7 Minutes of the 1st Committee Meeting held on the 21st November 1919
- 8 *Jnl. IEE*: 1920, **58**, pp. 638-639
- 9 *Ibid.*, pp. 858-869
- 10 *Ibid.*, p. 572
- 11 Op. cit., 1921, **59**, pp. 56-60
- 12 *Ibid.*, pp. 94-107
- 13 *Ibid.*, pp. 181-213
- 14 *Ibid.*, pp. 389-402
- 15 Op. cit., 1922, **60**, pp. 43-48  
See obituary notice, *Jnl. IEE*, July-Dec. 1940, **87**, p. 711
- 16 *Ibid.*, pp. 308-314
- 17 Minutes, Liverpool Sub-Centre, 16th January 1922
- 18 *Jnl. IEE*, 1922, **60**, p. 398
- 19 *Ibid.*, pp. 287-298
- 20 Op. cit., 1923, **61**, pp. 31-34
- 21 Minutes, Liverpool Sub-Centre, 13th November 1922

## CHAPTER 5

- 1 *Jnl. IEE*, 1923, **61**, pp. 417-424
- 2 *The Times*, obituary notice, 3rd July 1961
- 3 *Jnl. IEE*, 1924, **62**, pp. 31-36  
The biographical details are based on an obituary notice published in the *Jnl. IEE*, 1937, **81**, July-Dec., pp. 819-20
- 4 *Ibid.*, pp. 385-418
- 5 *Ibid.*, pp. 729-755
- 6 Op. cit., 1925, **63**, 305-308
- 7 *Ibid.*, pp. 69-113
- 8 *Ibid.*, pp. 157-172
- 9 *Ibid.*, pp. 521-536



- 10 Op. cit., 1926, **64**, pp. 21–24  
Biographical details will be found in the obituary notice published in the *Jnl. IEE*, 1931, **69**, p. 1322
- 11 *Ibid.*, pp. 193–200
- 12 *Ibid.*, p. 208
- 13 *Ibid.*, pp. 97–125
- 14 *Ibid.*, pp. 289–301
- 15 *Ibid.*, pp. 1098–1148
- 16 Op. cit., 1927, **65**, pp. 29–33
- 17 *Ibid.*, pp. 97–112
- 18 Michael Faraday's work is described in 'Experimental researches in electricity', in three volumes, originally published in London in 1839, 1844 and 1855, respectively. The material consists of papers reprinted from various journals, including the *Proceedings of the Royal Institution*. The work was reissued by Dover Publications, New York, in 1965, in three volumes, and in the UK by Constable
- 19 *Jnl. IEE*, 1927, **65**, pp. 674–680  
Biographical details will be found in the *Jnl. IEE*, 1944, **91**, Pt. 1, p. 475
- 20 *Jnl. IEE*, 1927, **65**, pp. 733–751
- 21 *Ibid.*, pp. 752–761
- 22 Op. cit., 1928, **66**, pp. 39–43
- 23 *Ibid.*, pp. 125–130
- 24 *Ibid.*, pp. 712–734
- 25 Op. cit., 1946, **93**, Pt. 1, pp. 614–615
- 26 Op. cit., 1929, **67**, pp. 30–34
- 27 *Ibid.*, pp. 217–240
- 28 *Ibid.*, pp. 937–945
- 29 Op. cit., 1930, **68**, pp. 51–56
- 30 *Ibid.*, p. 753
- 31 *Ibid.*, pp. 657–665
- 32 *Ibid.*, pp. 1369–1453
- 33 Op. cit., 1931, **69**, pp. 39–45
- 34 *Ibid.*, pp. 1357–1362
- 35 Op. cit., 1931–32, **70**, pp. 47–53
- 36 *Ibid.*, pp. 189–235
- 37 Op. cit., 1933, **72**, pp. 37–40
- 38 *Ibid.*, pp. 1–10
- 39 *Ibid.*, pp. 189–220
- 40 Op. cit., 1933, **73**, pp. 97–113

## CHAPTER 6

- 1 *Jnl. IEE*, 1934, **74**, pp. 49–54
- 2 *Ibid.*, pp. 285–297
- 3 Op. cit., 1935, **76**, pp. 26–34
- 4 *Ibid.*, pp. 241–258
- 5 Op. cit., Jan.–June 1936, **78**, pp. 28–33
- 6 *Ibid.*, pp. 123–140
- 7 *Ibid.*, p. 121
- 8 Op. cit., July–Dec. 1936, **79**, pp. 617–627
- 9 Op. cit., Jan.–June 1937, **80**, pp. 41–45
- 10 *Ibid.*, pp. 237–268
- 11 Op. cit., July–Dec. 1937, **81**, pp. 821–822
- 12 Op. cit., Jan.–June 1938, **82**, pp. 44–48
- 13 *Ibid.*, pp. 565–582
- 14 Op. cit., Jan.–June 1939, **84**, pp. 38–42
- 15 Op. cit., July–Dec. 1938, **83**, pp. 437–455

- 16 *Ibid.*, pp. 729–757
- 17 *Ibid.*, pp. 758–792
- 18 Op. cit., **84**, pp. 597–609
- 19 Op. cit., July–Dec. 1938, **83**, pp. 581–617
- 20 Op. cit., Jan.–June 1939, **84**, 'Report of the Council for 1938–1939'

## CHAPTER 7

- 1 *Jnl. IEE*, Jan.–June 1940, **86**, p. 506
- 2 *The Times*, obituary notice, 27th May 1972
- 3 Personal communication dated 27th December 1971
- 4 *Jnl. IEE*, Jan.–June 1940, **86**, pp. 27–30
- 5 *Ibid.*, pp. 345–354
- 6 Op. cit., July–Dec. 1940, **87**, pp. 76–100
- 7 *Ibid.*, pp. 461–473
- 8 *Ibid.*, pp. 615–624
- 9 *Ibid.*, pp. 625–656
- 10 Op. cit., 1941, **88**, General, Pt. I, pp. 84–87
- 11 Op. cit., Jan.–June 1940, **86**, pp. 225–239
- 12 *Ibid.*, p. 351
- 13 Op. cit., 1942, **89**, Pt. I, pp. 77–80
- 14 *Ibid.*, Pt. III, pp. 43–64
- 15 *Ibid.*, p. 244
- 16 Op. cit., 1943, **90**, Pt. I, pp. 67–70
- 17 *Ibid.*, p. 4
- 18 Personal communication from J. Cormack, dated 27th December 1971
- 19 *Jnl. IEE*, 1944, **91**, Pt. I, pp. 65–69
- 20 *Ibid.*, Pt. II, pp. 35–51
- 21 Op. cit., 1943, **90**, Pt. III, pp. 90–114
- 22 Op. cit., 1945, **92**, Pt. I, pp. 69–72
- 23 Personal communication dated 27th December 1971
- 24 *Jnl. IEE*, 1945, **92**, Pt. I, p. 2 and p. 225
- 25 *Ibid.*, Pt. III, pp. 255–267

## CHAPTER 8

- 1 *Jnl. IEE*, 1946, **93**, Pt. I, pp. 74–78
- 2 Op. cit., 1947, **94**, Pt. I, pp. 83–86
- 3 *Ibid.*, pp. 233–242
- 4 Op. cit., 1948, **95**, Pt. I, p. 79
- 5 *Ibid.*, Pt. II, pp. 470–479
- 6 Op. cit., 1949, **96**, Pt. I, pp. 9–10
- 7 *Ibid.*, p. 225
- 8 'Liverpool University: a Jubilee book', 1953, p. 30
- 9 The first report of the British Electricity Authority for the period 13th August 1947 to 31st March 1949 was published in January 1950

## CHAPTER 9

- 1 *Proc. IEE*, 1952, **99**, Pt. I, pp. 16–17
- 2 *Ibid.*, pp. 75–88
- 3 *Ibid.*, Pt. II, pp. 189–202
- 4 Op. cit., 1953, **100**, Pt. I, pp. 12–13



- 5 Op. cit., 1952, **99**, Pt. II, pp. 297-309
- 6 Op. cit., 1954, **101**, Pt. I, pp. 15-16
- 7 Op. cit., 1953, **100**, Pt. II, pp. 115-124
- 8 *Ibid.*, Pt. I, p. 253
- 9 Op. cit., 1955, **102**, Pt. A, pp. 1-6
- 10 *Ibid.*, pp. 157-158
- 11 *J. IEE*, 1955, **1**, pp. 179-180
- 12 Op. cit., 1958, **4**, pp. 15-21
- 13 Op. cit., 1957, **3**, pp. 142-148
- 14 *Proc. IEE*, 1958, **105**, A, pp. 22-23
- 15 *J. IEE*, 1958, **4**, pp. 282-283, 551-552
- 16 *Jnl. IEE*, 1951, **98**, p. 169
- 17 *Proc. IEE*, 1959, **106**, Pt. A, pp. 104-106
- 18 Op. cit., 1960, **107**, Pt. B, pp. 16-18

## CHAPTER 10

- 1 *Proc. IEE*, 1961, **108**, Pt. A, pp. 25-26
- 2 CARR: p. 47
- 3 *J. IEE*, 1962, **8**, p. 125
- 4 *Proc. IEE*, 1963, **110**, (1), pp. 1034-1035
- 5 COOPER, A. R.: 'Sebastian de Ferranti—pioneer of power', *Electron. & Power* 1964, **10**, pp. 402-405.  
A booklet entitled 'S. Z. de Ferranti: a brief account of some aspects of his work' was prepared by Arthur Ridding, A.M.S.A., (*AM*), who at that time was the Archivist of the Ferranti Collection of manuscripts, printed documents and photographs. It was published by HMSO for the Science Museum, South Kensington, in the Centenary year
- 6 The biographical details have been compiled from the *Jnl. IEE*, 1930, **68**, obituary notice, pp. 1532-1533, and 'The life and letters of Sebastian Ziani de Ferranti' by Gertrude Ziani de Ferranti and Richard Ince (Williams & Norgate, 1934, reprinted 1956)
- 7 The original drawing is in the Ferranti Archives. It has not been reproduced previously
- 8 Ferranti and Ince, p. 120
- 9 *Electron. & Pwr.*, 1965, **11**, pp. 272-275
- 10 *Proc. IEE*, 1968, **115**, pp. 100-102
- 11 'The University of Liverpool calendar'
- 12 The biographical notes have been based mainly on the 'Profile' published in the *J. IEE*, 1968, **14**, p. 416
- 13 A shortened version is published in the *J. IEE*, 1968, **14**, pp. 431-433
- 14 *Proc. IEE*, Jan.-June 1969, **116**, pp. 167-168

## CHAIRMEN OF THE SUB-CENTRE AND CENTRE

## CHAIRMEN OF THE LIVERPOOL SUB-CENTRE OF THE NORTH-WESTERN CENTRE

1919-20	E. W. Marchant	1921-22	G. H. Nisbett
1920-21	H. Dickenson	1922-23	B. Welbourn*

\* Mr. Welbourn became the first Chairman of the Mersey & North Wales (Liverpool) Centre in February 1923

## CHAIRMEN OF THE MERSEY &amp; NORTH WALES (LIVERPOOL) CENTRE

1923-24	L. M. Hollingworth	1933-34	B. Welbourn
1924-25	H. H. Harrison	1934-35	R. G. Devey
1925-26	A. E. Malpas	1935-36	O. C. Waygood
1926-27	P. J. Robinson	1936-37	F. E. Spencer
1927-28	F. J. Teago	1937-38	G. K. Paton
1928-29	S. E. Britton	1938-39	E. L. Morland
1929-30	E. W. Marchant	1939-40	W. Holtum
1930-31	A. J. Pratt	1940-41	J. E. Nelson
1931-32	P. M. Hogg	1941-42	E. G. Taylor
1932-33	A. C. Livesey	1942-43	H. Pryce-Jones

## CHAIRMEN OF THE MERSEY &amp; NORTH WALES CENTRE

1943-44	T. E. Houghton	1958-59	J. Collins
1944-45	J. B. Cormack	1959-60	T. A. P. Colledge
1945-46	J. O. Knowles	1960-61	D. A. Picken
1946-47	R. Varley	1961-62	R. N. Pegg
1947-48	P. C. Barnes	1962-63	J. A. Mason
1948-49	T. B. D. Terroni	1963-64	W. J. J. Curry
1949-50	D. C. Fleming	1964-65	J. M. Cowan
1950-51	J. Eccles	1965-66	D. M. MacLaren
1951-52	E. W. Ashby	1966-67	E. Jacks
1952-53	W. A. Hatch	1967-68	F. J. Hyde
1953-54	T. Coates	1968-69	E. F. Duncan
1954-55	P. R. Dunn	1969-70	S. Towill
1955-56	J. M. Meek	1970-71	D. H. C. McAuslan
1956-57	P. d'E. Stowell	1971-72	C. E. R. Fairburn
1957-58	T. Makin	1972-73	D. G. Gwyn



## HONORARY SECRETARIES OF THE SUB-CENTRE AND CENTRE

### HONORARY SECRETARY OF THE LIVERPOOL SUB-CENTRE OF THE NORTH-WESTERN CENTRE

1919-23 O. C. Waygood

### HONORARY SECRETARIES OF THE MERSEY & NORTH WALES (LIVERPOOL) CENTRE

1923-35 O. C. Waygood

1935-43 W. Parry

### HONORARY SECRETARIES OF THE MERSEY & NORTH WALES CENTRE

1943-45 W. Parry

1960-64 G. S. Shepherd

1945-54 A. V. Milton

1964-67 B. F. Tickle

1954-56 J. W. Lynn

1967-69 G. W. Launder

1956-60 S. Towill

1969-72 H. Currie

1972- D. B. McRobert

## HONORARY TREASURERS OF THE SUB-CENTRE AND CENTRE

### HONORARY TREASURER OF THE LIVERPOOL SUB-CENTRE OF THE NORTH-WESTERN CENTRE

1919-23 O. C. Waygood

### HONORARY TREASURERS OF THE MERSEY & NORTH WALES (LIVERPOOL) CENTRE

1923-25 O. C. Waygood

1925-34 L. Breach

1934-43 R. B. C. Stirrup

### HONORARY TREASURERS OF THE MERSEY & NORTH WALES CENTRE

1943-47 R. B. C. Stirrup

1961-69 S. Towill

1947-61 W. Parry

1969- N. Clarke

## MEMBERSHIP

<i>Year</i>	<i>Members</i>	<i>Associate Members</i>	<i>Companions</i>	<i>Associates</i>	<i>Graduates</i>	<i>Students</i>	<i>Total</i>
1930	63	188	—	58	52	104	463
1945	81	310	—	56	164	284	895
1950	107	393	2	88	230	286	1186
1955	97	497	2	85	401	170	1252
1960	114	641	2	86	514	155	1512
1965	136	709	2	76	554	220	1697

<i>Year</i>	<i>Fellows</i>	<i>Members</i>	<i>Com- panions</i>	<i>Associates (former class)</i>	<i>Associate Members</i>	<i>Associates (new class)</i>	<i>Students</i>	<i>Total</i>
1970	156	765	3	46	688	65	194	1917