BIOGRAPHICAL MEMOIRS

Geoffrey Bertram Robert Feilden CBE. 20 February 1917 – 1 May 2004: Elected F.R.S. 1959

Kelvin Bray and Alexander Moulton

Biogr. Mems Fell. R. Soc. 2005 **51**, 135-148, published 1 December 2005

GEOFFREY BERTRAM ROBERT FEILDEN CBE

20 February 1917 — 1 May 2004

Biogr. Mems Fell. R. Soc. **51**, 135–148 (2005)

GEOFFREY BERTRAM ROBERT FEILDEN CBE

20 February 1917 — 1 May 2004

Elected FRS 1959

By Kelvin Bray[1] CBE FREng and Alexander Moulton[2] CBE FREng

[1] *University of Lincoln, Brayford Pool, Lincoln LN6 7TS, UK*
[2] *The Hall, Bradford-on-Avon, Wiltshire BA15 1AJ, UK*

Introduction: the father of the industrial gas turbine in Europe

Bob Feilden will be remembered by scientists and engineers around the world for his innovative work on industrial gas turbines which became, in the Ruston Type TA gas turbine, a prime mover of choice for all those who wanted high reliability and automatic or remote operation.

In 1946 Feilden was recruited by Ruston and Hornsby Ltd, a leading maker of diesel engines, to work on industrial gas turbines, after his outstanding work with the Whittle team on the world's first jet engines. The company required new products for the postwar years and felt that the rotating machine was a candidate and, in any event, posed a threat to their reciprocating engines on the ground, as it had done in the air for its reciprocating predecessors. Although the transformation took much longer for ground-based equipment than it had in the air, the unique combination of kinematic design and early aircraft gas turbine technology, conjured by Feilden, produced an excellent machine with an initial rating of 750 kW and which went into production in 1952 (1)*.

After many upratings with later technology, exploiting the capacity of the original design, the TA was still in production 37 years later. By then the TA and its successors were operating in 75 countries and on offshore oil and gas production platforms in the Middle and Far East, South America, the USA, the North Sea and the Mediterranean.

This activity changed for ever the industrial landscape of Lincoln, where the present owner of the gas turbine business, Siemens, continues to benefit from the far-sighted work by

* Numbers in this form refer to the bibliography at the end of the text.

Feilden. Theirs is the only major remaining industrial activity in a city that, over the years, has also been home to the manufacture of tanks, automobiles, aero engines, locomotives, pumps, gearboxes, diesel engines, aeroplanes and excavators.

The early days: Hampstead and Canada

Feilden was born on 20 February 1917 in Meadway Court, Hampstead Garden Suburb, London, N.W.11, at a worrying time for a family living through the Zeppelin bombing raids on London. He spent his early years on a small ranch at Mara in British Columbia, where doctors advised the climate would suit his father, Major Robert Humphrey Feilden, who had been recalled from the Western Front during World War I as a victim of a gas attack.

Feilden's early education was at Mara school next door to the Feilden home, where he was taught the three R's including 'muscular movement' writing. In this, he learnt, the whole of the forearm moves giving rise, apparently, to the uniformly rounded characters in the writing of many from North America—although for some reason his writing was not so affected.

Even as a child, on a remote ranch in western Canada, Feilden found expression for his growing technical interests. He investigated the workings of the single-wire telephone system in the Okanagen Valley and carried out rudimentary experiments on the Leclanché cells discarded by the telephone company. After his father tragically died, while bathing in a lake, the young Feilden was sent back to England to be educated, because his mother felt the eldest of her five sons deserved a better education than was available in the Okanagen Valley. At the end of the Atlantic crossing in Liverpool, the inquisitive eight-year-old enjoyed the experience of being allowed onto the bridge to 'steer' the Canadian Pacific ship *Montrose* for a short time.

Bedford School and King's College, Cambridge

After Heath Mount School in Hampstead he went to Bedford School, where he became a Major Scholar and in due time won an Open Exhibition in Mathematics and Physics to King's College, Cambridge. Leaving Bedford School at the end of 1935 he went as an engineering apprentice to BTH (British Thomson-Houston) at Rugby and, while there, took a course in engineering drawing at Rugby Technical College before going up to Cambridge in October 1936 to read the Mechanical Sciences Tripos. During the long vacation in 1937, by arrangement with the University Appointments Board, Feilden went to work for two months at the Brown Boveri Company at Baden in Switzerland. He went on his motor bike, finding it necessary to fit two new piston rings en route and still catching the ferry on time! Brown Boveri was experimenting with gas turbines derived from steam turbine technology at the time, and this no doubt whetted Feilden's appetite for this new kind of prime mover.

For the summer of 1938, also by arrangement with the Appointments Board, Feilden went as a supernumerary Fifth Engineer on the tanker *Gold Shell* from Rotterdam to Curaçao (in ballast) and then back to Rotterdam with fuel for Germany, seeing at first hand the problems associated with big slow-speed marine diesel engines.

At King's he was promoted from Exhibitioner to Scholar and obtained first-class honours in the Mechanical Sciences Tripos after two years in 1938 and followed that with an upper second in the Economics Tripos Part II in 1939. He had rather hoped that the Economics Tripos

would be an introduction to industrial management, but having done it he doubted that it was. He knew, however, that the First in the Mechanical Sciences Tripos was all-important. Later in life it gave Feilden great pleasure to see his son Richard and then his grandson Angus follow him to King's.

The war years, Whittle, and Power Jets

After Cambridge, Feilden went to Unilever at Port Sunlight as a technical trainee. Before he set off from Bedford on 4 September 1939, he heard Neville Chamberlain's announcement of war with Germany. As part of the war effort he was directed to Power Jets Limited because of his experience at Brown Boveri. At his interview he asked whether they were working on a gas turbine for aircraft use and was hurriedly asked to sign the Official Secrets Act and was promptly employed!

By 1940 all efforts at Power Jets were directed towards getting the W1 engine airworthy for its test flights in the Gloster E28/39 prototype, which had been designed especially for it. Feilden managed the test programme and when the engineers drew lots at the insistence of Frank (later Sir Frank) Whittle (FRS 1947), to decide who would install the W1X engine for taxiing trials, Feilden won. The trials took place in conditions of secrecy at Brockworth Airfield in Gloucestershire near the Gloster factory and, although the test pilot had been warned that the engine contained some non-airworthy parts, on the second day of taxiing trials on 8 April 1941 he nevertheless had the aeroplane airborne for 200 yards, landed uneventfully and then repeated the process two more times! Feilden was to say later, 'that was the most exciting day of my life'.

Subsequently the Gloster-Whittle E28/39 was successfully flown with the flight engine at RAF Cranwell in Lincolnshire in May 1941, and the course of air transport in the future was changed forever.

When production got under way, Feilden was first put in charge of inspection and then the experimental workshop, all of which was to become very valuable in the next phase of Feilden's career. Before that, however, came the now famous presentation of Sir Frank Whittle's Thomas Hawksey Lecture in 1945. One of Feilden's last tasks before leaving Power Jets in 1946 was a tour repeating the lecture, which, as it happened, increased interest in industrial gas turbines. He addressed an audience of 2500 in Dundee and several projects were started by the established steam turbine builders in the manner of Brown Boveri in Switzerland.

The reactionaries

It seems to be inevitable that when a group of people are involved with some intensity in ground-breaking innovation, a strong camaraderie develops, particularly when there is a perception that the work is not strongly supported by others. This was certainly the case with the 'Reactionaries', so called because it was felt that the forward propulsion of aircraft by reaction from the backward momentum of a high-velocity stream of hot gas was considered to be a vivid illustration of Newton's Third Law—that action and reaction are equal and opposite. (Feilden, in the Cambridge manner, very often liked to relate explanations to 'first principles'.)

Former members and associates of Whittle's team at Power Jets who worked with him from 1937 to 1945 decided in 1946 (after the nationalization of the company in 1945) to become Reactionaries to keep in touch with each other and with Whittle in the future through annual newsletters and reunions, and this they did regularly for the next 45 years.

Ruston and Hornsby

After the war, Feilden joined Ruston and Hornsby Limited in Lincoln in 1946 in rather interesting circumstances. The Managing Director of Ruston, Victor Bone, had a son, Geoffrey Bone, who, as an RAF officer, had been attached to Whittle's team and, when the Chief Engineer at Ruston suggested they should work on gas turbines, Feilden's name was suggested by Bone junior to his father. As at Power Jets, Feilden worked once again in conditions of some secrecy, now being called 'Engineer-in-Charge, Internal Combustion Development Department' so as not to advertise the fact that Rustons were beginning work on industrial gas turbines. As was to become his style, he surrounded himself with a small personally selected team of specialists in the field from Power Jets and elsewhere and, with an eye to the future, began to recruit the next generation from universities, especially Cambridge including, as it happened, the future leader of the gas turbine business at Lincoln.

While at Power Jets, Feilden had become very interested in the principles of kinematic design—that is to say, a design that will withstand rapid changes of load and consequently temperature without harmful deformation and distress. Feilden regularly sketched his ideas for colleagues, often with considerable impact as, being ambidextrous, he could switch from one hand to the other in mid-flight! Kinematic design was an entirely new concept at the time because most other prospective builders of industrial gas turbines were basing their designs on established steam turbine practice, in which the heavy scantlings demanded long startup and shutdown procedures. Feilden's team resolved that by using aero-derived experience they could avoid such difficulties and they even set themselves a startup time of 1 minute. In the event this groundbreaking target was achieved relatively easily for the mechanical design, but in the days before electronic controls it was a real challenge for the best contemporary hydro-mechanical controls.

The prototype ran in 1949 and soon afterwards there was the first order—from the 'Air Ministry' for three transportable sets. Later orders began to come from the oil companies, who, much encouraged by a Swiss colleague of Feilden's, John Albertini, who led the sales efforts at Ruston, realized the advantages of these prime movers for pumping oil in arid regions. The gas turbines were much lighter than their predecessor reciprocating engines, were easier to install, had much longer life and required far less maintenance. The oil companies were well known for their understandably conservative approach to equipment selection, bearing in mind the often remote nature of their locations and the huge cost of failure, so the early orders were small and tentative.

Nevertheless the new machine received an unexpected fillip and came to the notice of the British and international press and others in 1953, when the Engineering and Marine Exhibition at Olympia in London was threatened by an electricians' strike. The Ruston TA gas turbine, sent there as an exhibit, was put to work and generated all the power for the Show demonstrating, for all to see, the ease of installation already noted by some oil companies!

The postwar years 1946–59 cemented Feilden's relationship with Lincoln, one that was to leave a lasting and positive impression on both the man and the city itself. Feilden's excep-

tional pioneering work in Lincoln was recognized when he was elected a Fellow of the Royal Society, in those days a rare privilege for a practising engineer and one that gave huge pleasure to a 42-year-old Feilden.

Feilden left Ruston and Hornsby in 1959, and his legacy as Technical Director there included the TA turbine (providing maintenance-free service for much longer periods than were possible with diesel engines) and the AT diesel engine (designed for the industrial and marine market and also benefiting from several innovative features derived by going back to the first principles of the design). Most importantly of all he left an engineering approach that was to blossom into a major international business and colleagues who had a huge respect for his intellect and personal qualities.

Ruston and Hornsby Ltd was acquired in 1969 by English Electric, ironically for the diesels rather than the gas turbines which, in sales terms, then still represented a very small part of the total. English Electric, in its turn, merged with GEC. Then the gas turbine activity rapidly expanded and annual sales went from £1 million to more than £150 million in 10 years and much more later. The management under Kelvin Bray, whom Feilden had recruited from Cambridge in 1956, was strongly supported by Lord Weinstock, the Managing Director of GEC. They always acknowledged their debt to Feilden and in 1983, when they won the MacRobert Award for their latest gas turbine, the Tornado, they had insisted on his inclusion in the citation in view of the crucial importance of his work on the earlier TA.

The gas turbine operation continued successfully in Lincoln under a series of owners including GEC and Alstom before being taken over in 2003 by Siemens, a world leader in the field of power generation.

Hawker Siddeley Brush Turbines

Early in 1959 Hawker Siddeley were advertising for a Managing Director of a company building steam and gas turbines. In view of this most unusual opportunity Feilden accepted the position of Managing Director of Hawker Siddeley Brush Turbines Ltd (HSBT). The company was formed after the acquisition of Brush by Hawker and was to be established in part of the Gloster Aircraft Works at Hucclecote, to which Feilden was no stranger. It soon became clear that the product portfolio of HSBT was deficient compared with Rustons, and it was going to be difficult, if not impossible, to produce a viable company. Looking back on this, with the advantage of experience 40 years later, Feilden felt that his decision to leave Rustons was excessively influenced by personal matters, not least the opportunity to live in Gloucestershire.

Davy Ashmore

In the event he was, in November 1959, appointed Group Technical Director of Davy-Ashmore Ltd, based at the company's London headquarters at Portland Place. His duties included the coordination of all the design and development activities throughout the group at its sites in Sheffield, Stockton, Glasgow and Hull, which he visited personally on a regular basis. Several major projects were successfully completed, but because the timescale for improvements in the process industries was so long, there were no spectacular breakthroughs in the eight years that Feilden spent at Davy-Ashmore.

The Royal Academy of Engineering and the Royal Society

He was very proud that three of his four senior colleagues at Davy-Ashmore were elected Fellows of the Royal Academy of Engineering, of which he was a Founder Fellow. Feilden had been extremely enthusiastic about the Fellowship of Engineering, as it was initially called, and together with 125 other eminent engineers of the time he was present at the inaugural meeting on 11 June 1976 in Buckingham Palace, hosted by HRH Prince Philip as the Senior Fellow after his years of advocacy regarding the formation of the Fellowship.

Feilden had also become active in the Royal Society and served for two periods on its Council. He made substantial contributions to the affairs of the Society, especially in official visits overseas. His first visit was with the delegation to the Soviet Union in 1965, which marked a further reduction in Soviet isolation and the acceleration of their reconstruction after wartime devastation. During the visit to India in 1967, Feilden advised on the expansion of the gas turbine research establishment at Bangalore and was delighted many years later, in 1996, to see the progress made. He visited China twice, once in 1975 with the Royal Society and then in 1980 as leader of a British Standards Institution (BSI) delegation—the first of these was to exchange views with the Chinese Academy of Sciences and the second was to promote international standardization. Finally, in 1968, he visited several countries in Latin America with a delegation briefed to explore expansion in the automotive and aircraft industries, where development did subsequently proceed apace, especially in Brazil.

The Feilden Report

As Chairman of what came to be known as the Feilden Committee he was the author in 1963 of the Feilden Report (2) on Engineering Design, commissioned by Lord Hailsham, the Minister for Science at the time. The Report proved to be a ‘best seller’ for the DSIR (Department of Scientific and Industrial Research), with 10 000 copies being printed. This report was the origin of the expression ‘In design, everything matters’.

After the publication of the report, Feilden was an energetic Chairman of the Engineering Design Advisory Committee of the Design Council, which had been renamed to promote improvement in engineering as well as industrial design. Thousands of manufacturing companies benefited from the funded consultancy service provided by the Design Advisory Service. With sponsorship from the BSI and the Engineering Council, as it then was, 43 engineering design guides were published on subjects as diverse as fastening systems, seals, helical springs and permanent magnets. Warm support was given by the engineering institutions and several set up their own design promotion activities. For his work on engineering design, Feilden was awarded the CBE in 1966.

The BSI and international standards

As a result of head hunting, Feilden joined the BSI as Deputy Director General in 1968 and became Director General in 1970, but he had been closely involved with BSI at an earlier date. The Feilden Report on Engineering Design was published in 1963 and it contained criticisms of several aspects of the working of the BSI, principally that national standards could inhibit

good design and should be written in such a manner as to promote good design, and also that the process of standards preparation was too slow.

In 1970 the BSI was heavily committed to the 10-year programme of metrication, following the government decision in May 1965 that industry should change to the metric system and that the BSI should have responsibility for planning and coordinating the change. The first part of the programme went well, dealing with the revision and metrication of methods of test, but delays occurred with product standards, partly because some industries were reluctant to agree to truly metric ranges and preferred straight conversions of the imperial dimensions of products. Feilden joined the BSI at about this stage.

This, and the increasing emphasis on international work, meant that, in the five years before Feilden's time, the staff numbers were increased by 50%, with resulting problems of accommodation and of funding. Thus he joined the BSI at a challenging time, when management and accounting systems had not developed to meet the needs of the still-expanding organization.

New accounting systems were put in place and steps were taken to improve the financial situation by the introduction of a new subscription scheme for members, from industry and commerce, and by negotiating additional funding by the Department of Trade and Industry, which sponsored the BSI.

As an engineer, Feilden was surprised to find that the BSI had no written rules or procedures for the preparation of national standards other than a collection of 'office circulars' issued from time to time setting down new requirements. He quickly put in hand the preparation of a standard, establishing procedures for the various aspects of the work of the BSI, including general principles of standardization, committee procedures and the drafting and presentation of standards—famously called 'BS 0: A Standard for Standards', which was published in four parts in February 1974. This critical review of the standards process resulted in an important change in principle, from writing dimensional product specifications to performance-based product specifications. Thus, one of the criticisms in the Feilden Report was met—that national standards should promote good design and not inhibit it.

Feilden made great steps in increasing the UK's influence, which was already strong, in international standardization activities. He was very successful within the International Organization for Standardization (ISO) as a highly respected member of its Council and Executive Committee and as President of the European Standards Body (CEN) in 1978 and 1979. Participation in international standardization was of vital importance for UK industry in almost all areas to facilitate worldwide trade, but particularly trade with other European countries, as the UK prepared for entry into the Common Market. At one time the UK held the secretariats of major policy and technical committees within the ISO and the IEC (International Electrotechnical Commission), with resulting benefits for industry. However, this level of international activity outstripped the available finance and manpower resources provided by industry, and in 1972 the BSI Executive Board set up an International Policy Panel to reassess UK participation and to set priorities.

Throughout the 1970s Feilden saw the need for the rapid expansion of the Hemel Hempstead Centre, as a national focus for certification, testing and inspection and export support services. He supported the centralization of all these services through relocation of the Kitemark operation from London, to establish the integrated concept of BSI Quality Assurance Services. Earlier, he had been instrumental in establishing the BSI Quality Assurance Council, which he was well placed to do, given his excellent contacts. The unprecedented major and sustained capital investment in Hemel Hempstead was to continue elsewhere.

Towards the end of the decade it became obvious that the BSI needed yet more space and Feilden supported the Commercial Directorate in its recommendation to establish a second major centre in Milton Keynes. This was to provide for the relocation of commercial, marketing, information and finally quality assurance functions, variously from buildings in London and the Hemel Hempstead site.

The commitment to quality assurance concepts as a basis for self-financing BSI services for industry and commerce was confirmed by the mid-1970s in the publication of a feasibility study initiated by Feilden, after representations by Her Majesty's Government and the Confederation of British Industry. There were three key recommendations, which were to be pivotal in the development of quality assurance nationally, within the European Union and worldwide. They were: the development of a national quality assurance standard, to become BS 5750, the first part being published in 1979 and forming the precursor to the ISO 9000 series; a national scheme for the accreditation of certification bodies; and a national scheme for the attestation of test houses and laboratories. This work has had a lasting success—the millionth registration to the International Standard was made in 2004.

It was exciting for the staff to be part of this rapidly developing work programme and Feilden took them with him throughout the various stages—no mean feat. Each week a management meeting was held in Hampden House, giving an opportunity for all Directors and Heads of Department to discuss the latest developments and opportunities open to the BSI. He encouraged frank and open discussion, drawing in the most junior members of the management team. He was well known at these meetings for expounding Feilden's Laws—about ten in all, including the oft-quoted

'Do it once, do it right, do it internationally'

and

'Never let the best be the enemy of the good'.

As at Ruston and Hornsby, Feilden kept a keen eye on placing the right people in slots to further his plans for the future, whether it was to progress a specific project, for example the early work on particular standards, or on a wider front essential to the continuing modernization of the BSI, where he brought in external advisors to review strategy and practices alongside staff. As a result, new successful senior appointments were made in the areas of finance, marketing, production, personnel and property from both external and internal sources. BSI Policy Committees were strengthened by bringing in senior government officials and influential members of the manufacturing and commercial interests.

In paying tribute to Feilden, some of the lasting benefits to UK industry, commerce and consumers have been highlighted and the success of his policies relating to international forums have been touched on, but those who worked with him remember especially his kindness and thoughtfulness. He worked on the basis that if staff were treated well, the BSI would reap the benefits. As an outstanding engineer, and a perfectionist, he demanded high standards from those around him. He led the BSI soundly and imaginatively through a period of great change, such that the BSI and industry in general still reap the benefits.

Retirement in Painswick

Soon after his retirement (from the BSI) at the age of 66 years, Feilden and his wife, Diana, left Henley on Thames and bought 'Verlands' in Painswick, Gloucestershire, to where, for some time, they had been keen to move for family reasons. The house, overlooking the valley, had come on offer to them by chance from a friend; it was large and had a swimming pool, which he used daily. Sea bathing and skiing were his favourite outdoor activities, and every opportunity on foreign trips was taken for Diana and him to enjoy these. He would often combine such activities with his penchant for photography to maintain a record of his family and his professional life. According to his son, Richard, his perfectionism was often evidenced by his waiting for what seemed interminable periods for the clouds to be in the right position in a shot!

Feilden established Feilden Associates Ltd in an office in the house for his intended consultancy work. He was of the generation who had always been used to dictating to a secretary rather than himself typing or using a word processor, and throughout his retirement he was fortunate in having excellent part-time secretarial assistance.

Retirement gave him the time to pursue his engineering interests, and to meet the many friends whom he had made through the Royal Society and latterly the Royal Academy of Engineering. A major consideration was promulgating his involvement in International Standards unification. Extensive overseas trips were involved including to South Africa, Vancouver and many to mainland Europe.

He continued his lifetime interests in engineering subjects, especially the profundity of the analysis of elements of mechanical design of rotating and reciprocating machines. This talent had been lifelong, as shown by his results in the Mechanical Sciences Tripos at Cambridge and through his early work on rotor stress analysis with Whittle. The subjects included alternative power sources, which had earlier brought him into contact with the work of Sir Christopher Cockerell FRS on wave-power articulating rafts.

From the days of the Feilden Report and the Moulton Report, and over the course of the following decade, he had formed a friendship with Alex Moulton, who lived not far away at Bradford-on-Avon. Feilden was interested in his development of a new small coal-burning steam plant, as well as strongly encouraging him in the Moulton Formula Leaves (pocket book of loose leaves, each on a specific topic with methods and formulae for engineering calculations). From 1971 he rode a Moulton bicycle.

Feilden continued his long friendship with Sir Frank Whittle, especially during his visits to UK on his consultancy with Bristol Aero for a small gas turbine for oilwell drilling. He was helpful in providing supporting material for Whittle's election in 1988 to the Royal Designers of Industry Faculty of the Royal Society of Arts. It was a disappointment to Feilden that he himself had not been elected to the Faculty but his skills and great contributions to engineering design lay in the procedures and methods of the practice of design as much as in innovative and conceptual aspects, as he made clear in a lecture at Bath University (3).

He continued his active interest in the Smallpiece Trust (Trustee 1981–88) up to 2001, advising on organization and policy on choice of courses. He instigated the series of important lectures at the Royal Society. The first was by Sir George Porter (later Baron Porter; PRS 1985–90) and the last by Sir Denis Rooke FRS on 'Achievement by design'.

His interest in the internal combustion engine led him, while travelling in Australia, to his final and valuable consultancy with the Collins Motor Corporation. Development was being

done in the UK by Endair as the successors to Westlake. Feilden's advice was sought in 1988 on alternative facilities to speed the development. An attractive design of a 'flat eight' engine and Feilden's typical concern with the fatigue testing of the novel connecting rod were mentioned, but there is no evidence of the engine's having been brought to production.

In retirement Feilden continued to take a close interest in the Reactionaries, and in 1998, together with two former colleagues, he proposed the setting up of the Whittle Reactionaries Prize of the Institution of Mechanical Engineers, funded by substantial donations from 75 Reactionaries augmented by the Mechanicals. The annual prize was to be a sum of cash and an engraved medal for a young engineer submitting 'The most innovative and forward looking paper relating to aerospace propulsion'. The award was launched (4) in the Frank Whittle Room at Birdcage Walk on 16 December 1998. Subsequently Feilden was one of the 17 surviving members who attended the final reunion on 15 May 2001 to celebrate the 60th anniversary of the first flight.

Conclusion

Feilden died on 1 May 2004 at the age of 87, after a period of illness following an operation. His funeral took place in Gloucester Cathedral on 13 May 2004, and a memorial service was held in London on 28 September 2004 at St Paul's, Knightsbridge. On a personal level he is remembered for his love of his family, his intelligence, dignity, modesty and warmth. After retirement his home with Diana was a haven for both young and old. In his retirement years Feilden would proudly take some of his grandchildren to the Science Museum in London to show them what he called 'the most famous dent in the history of aviation'. One of the prize exhibits was the original Gloster E28/39 aircraft, the survivor of only two built, which undertook the first flight. The rear fuselage still showed the dent sustained when the test p ilot, Gerry Sayer, took off and bumped the rear of the fuselage with the steep ascent only made possible by the thrust of the jet engine.

Dr Feilden is survived by his former wife Elizabeth, two of their three children and his wife Diana and three stepchildren, and a total of 17 grandchildren. He was very proud of his son, Richard, and his eminence as a young architect. Richard died as a result of a tragic accident that occurred during the preparation of this text, so his contribution of personal information may be incomplete.

Honours and awards

1943 MA Cantab. (King's College)
1954 The Derby Medal of the Liverpool Engineering Society for the best paper of the year ('The Development of Industrial and Marine Gas Turbines')
1959 Elected to the Fellowship of the Royal Society
1966 CBE
1970 Honorary DTech, Loughborough University
1971 Honorary DSc, The Queen's University of Belfast
1976 Founder Fellow of the Royal Academy of Engineering
1983 Joint winner of the MacRobert Award for Engineering Innovation

1993 The Hodgson Prize of the Royal Aeronautical Society for the best non-technical paper of the previous year
2003 Honorary DTech, Lincoln University
2003 Freedom of the City of Lincoln

Service as part-time member

1947–60 Member of Aeronautical Research Council (Committees and Sub-committees)
1955–61, 1969–80 Member of Institution of Mechanical Engineers Council
1956–61 Member of British Transport Commission Research Advisory Council
1957–65 DSIR Visitor to Production Engineering Research Association
1961–65 Member of Council for Scientific and Industrial Research
1965 Member, Royal Society delegation to USSR
1962–63, 1965–69 Member of Council, the Royal Society
1966–78 Member of Design Council (formerly CoID)
1967–69 Vice-President, the Royal Society
1968 Member, Royal Society delegation to Latin America
1968 Technical Advisor to the Government of India
1968–84 Member of Visiting Committee to the Royal College of Art
1970–71 Member of Central Advisory Council for Science and Technology
1973–2001 Trustee, Maurice Lubbock Memorial Fund
1975 Member, Royal Society delegation to the People's Republic of China
1977–78 Deputy Chairman, Design Council
1977–79 President, European Committee for Standardisation
1977–84 Chairman, Visiting Committee to Royal College of Art
1981–88 Member of Smallpiece Trust
1982–2001 Non-executive Director, Plint and Partners Ltd
1983–86 Member of Research, Development and Engineering Committee of the Industrial Development Board for Northern Ireland
1989–97 UK delegate to the Committee on Data for Science and Technology

Acknowledgements

The authors were greatly helped in their work by the extensive notes on his life, which had characteristically been left by Dr Feilden. Margaret Langton, formerly his Technical Director at the BSI, very kindly provided her recollections on this important part of the Feilden career. Professor David Chiddick, the Vice Chancellor, and his colleagues at the University of Lincoln very kindly assisted the authors by reading and commenting on texts and typing the full bibliography, and a former colleague of Dr Feilden's, John Bennett-Powell, was most helpful with information on the Reactionaries. Finally the authors gratefully acknowledge the support of Siemens in the production of this document.

The frontispiece photograph was taken in 1984, and is reproduced with permission.

Bibliography

The following publications are those referred to directly in the text. A full bibliography, numbered as in the second column, is available from the Royal Society's Library and online at www.pubs.royalsoc.ac.uk.

(1) (5) 1956 (With J. D. Thorn & M. J. Kemper) A standard gas turbine to burn a variety of fuels. *Proc. Instn Mech. Engrs* **170**, 665–696.

(2) (16) 1963 (Chairman) *Engineering design.* Report of a Committee appointed by the Council for Scientific and Industrial Research to consider the Present Standing of Mechanical Engineering Design.

(3) (54) 1978 The designer's craft. Keynote address, University of Bath, School of Engineering, June.

(4) (71) 1999 Historical gathering takes place at IMechE. *NEWS* (*The Newsletter of the Institution of Mechanical Engineers*), January 1999, p. 1.