HENRY LEA

CONSULTING ENGINEER

1839 - 1912

HOARE LEA
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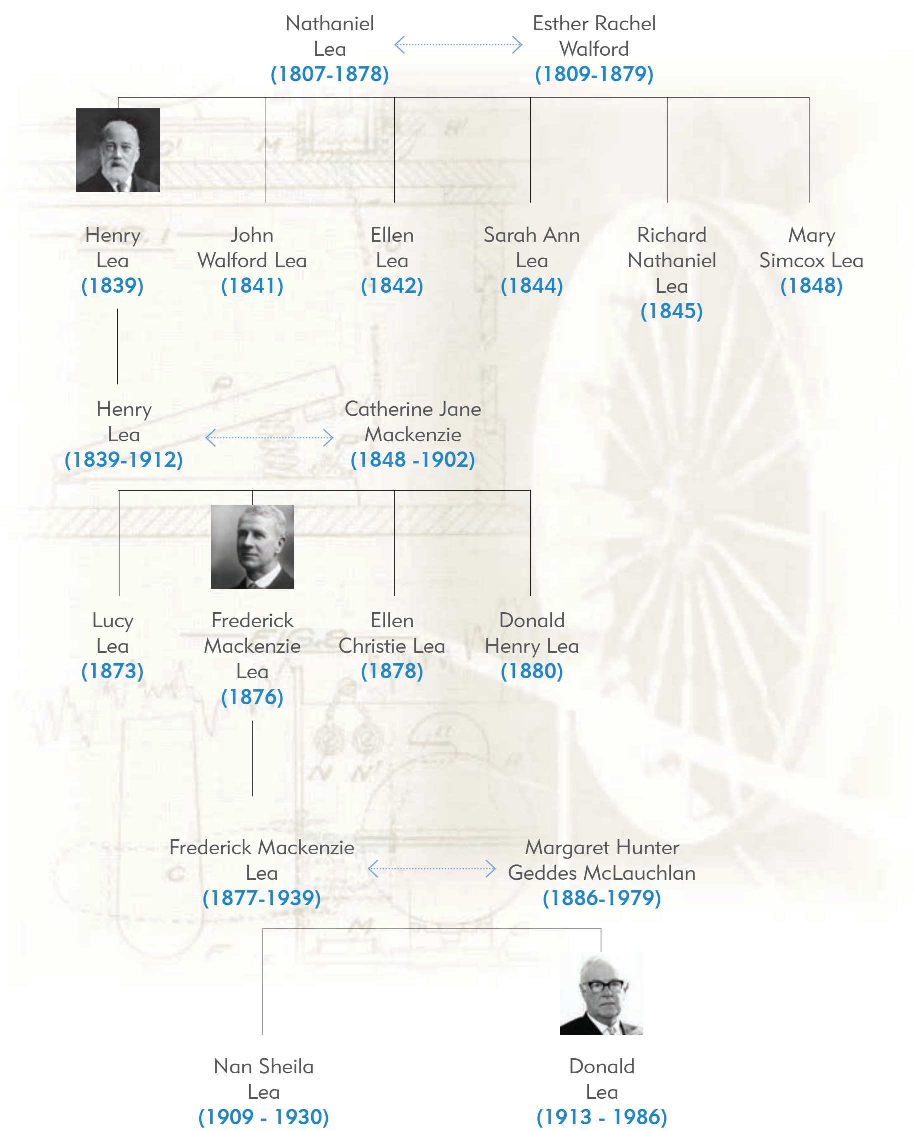
November 1862

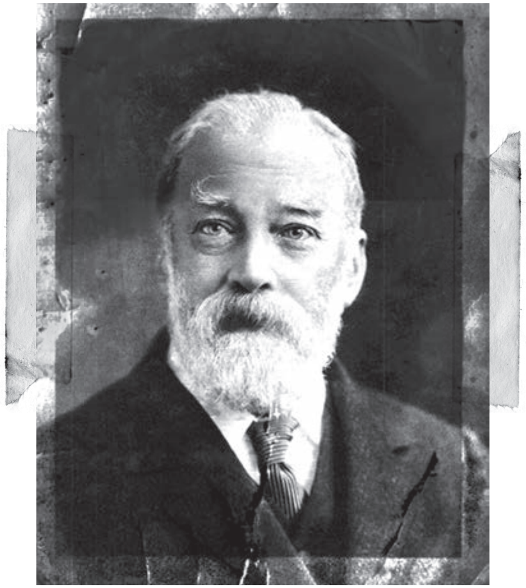
Henry Lea family tree



Introduction

Born on the 6 June 1839, Henry Lea was the eldest child of Nathaniel Lea and Ester Rachel Walford. Nathaniel Lea was the Chairman of the Birmingham Stock Exchange in 1845, at a time when Birmingham was becoming one of the most diverse industrial centres in the world.

Henry's life spanned the Victorian and Edwardian eras. He was an exceptional engineer and his expertise, covering the civil, mechanical and electrical engineering disciplines, put him in the right place at the right time to contribute to the tide of scientific and engineering development at the turn of the century.



Henry Lea (1839-1912)

Starting out

During Henry's childhood, Birmingham was a city of more than 500 small workshops crowded with artisans. It was in this dynamic setting that Henry studied at the King Edward VI School in New Street. He displayed a remarkable gift for mechanics and achieved first place in his year in mathematics in 1855.

Due to his natural inclination towards the sciences, Henry chose engineering as his profession. His first job, at the age of 16, was as an apprentice to John E Hodgkin, owner of the Suffolk Works, a small factory in Berkley Street, Birmingham. Henry began to gain knowledge of the practical side of engineering by day, whilst studying the theory by night.

During his apprenticeship, John Hodgkin's firm was acquired by Messrs May and Mountain, a firm of engineers, iron founders and millwrights. This takeover was beneficial for Henry, exposing him to a wider range of engineering works. An advert published in1861, stated:

Messrs May and Mountain

Manufacturing of high and low pressure steam engines, pumping, sawing and hoisting machinery, flour, sugar and mortar mills, hydraulic presses, railway iron work, boilers, boiler mountings and millwork.

Using the skills he gained in this role, he went on to join Walter Williams at Albion, Great Bridge Ironworks, Staffordshire. There, Henry gained experience in rolling mill practice and bridge building. He was clearly able, since at just 20 years of age he was sent to Northern Ireland to work on a swing railway bridge at Newry.

The bridge at Newry

In 1857, parliamentary permission was given to build a railway to improve links between the town of Newry and Belfast. To operate this line a "swivel bridge" was needed over the Clanrye River to enable vessels to pass into Carlingford Lough. The link cost £12,000 to build and Henry supervised the project. The line opened on 2 September 1861 and the bridge remained in use for more than 100 years, a testament to its robust design.

Photograph by courtesy of J D Fitzgerald

The 'Swivel' bridge over the Clanrye River, Newry (1860).

The First Consulting Mechanical Engineer

After the successful completion of the bridge at Newry, Henry was encouraged to carve out a career in engineering design consultancy. In November 1862, only a year after the completion of the railway at Newry, Henry opened an office at 33 Waterloo Street, Birmingham and sent a circular letter introducing himself:

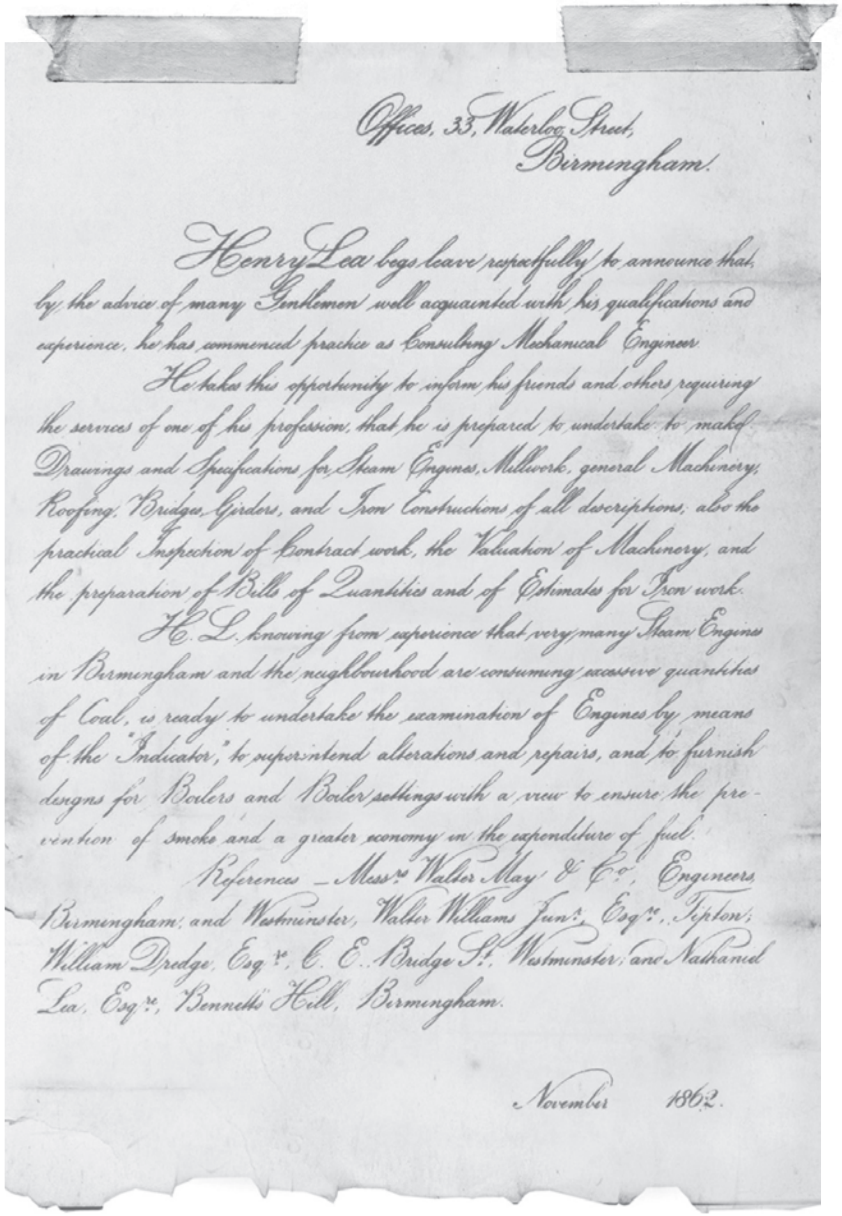
Henry Lea begs leave respectfully to announce that by the advice of gentlemen well acquainted with his qualifications and experience, he has commenced practice as Consulting Mechanical Engineer...

Henry thus wrote himself into the history of his profession, as the first in the field to describe himself as a Consulting Mechanical Engineer. The demand for larger more complex buildings required a new type of specialist advisory service, and the role of the Consulting Mechanical Engineer was born.

Henry's notebooks and correspondence still survive, providing a unique insight into his working methods. He took a great deal of pride in his work and meticulously recorded all of his assignments and any valuable data for reference in future work.

Henry's notebooks contained precise drawings and calculations as during many of his early assignments no ready-made statistics or tables of engineering data were available.

Henry contributed articles to the professional journals of his day, such as *The Engineer*, *The Builder*, and *The Electrician*,



Offices, 33, Waterloo Street,
Birmingham.

Henry Lea begs leave respectfully to announce that, by the advice of many Gentlemen well acquainted with his qualifications and experience, he has commenced practice as Consulting Mechanical Engineer.

He takes this opportunity to inform his friends and others requiring the services of one of his profession, that he is prepared to undertake to make Drawings and Specifications for Steam Engines, Millwork, general Machinery, Roofing, Bridges, Girders, and Iron Constructions of all descriptions, also the practical Inspection of Contract work, the Valuation of Machinery, and the preparation of Bills of Quantities and of Estimates for Iron work.

H. L. knowing from experience that very many Steam Engines in Birmingham and the neighbourhood are consuming excessive quantities of Coal, is ready to undertake the examination of Engines by means of the "Indicator," to superintend alterations and repairs, and to furnish designs for Boilers and Boiler settings with a view to ensure the prevention of smoke and a greater economy in the expenditure of fuel.

References — Messrs. Walter May & Co. Engineers, Birmingham and Westminster, Walter Williams Junr. Esqre. Tipton, William Dredge, Esqre. C. E. Bridge St. Westminster, and Nathaniel Lea, Esqre., Bennetts Hill, Birmingham.

November 1862.

Letter announcing Henry Lea as a Consulting Mechanical Engineer (1862).

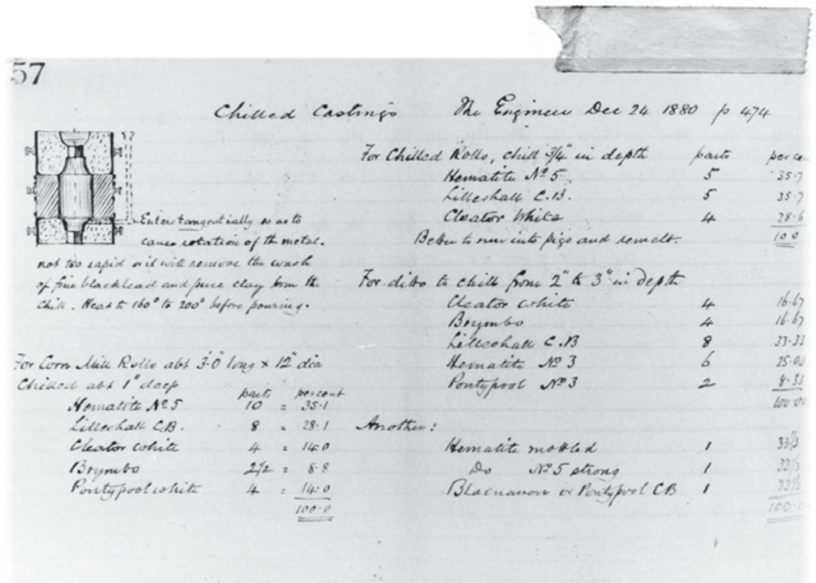
making a tremendously valuable contribution to the industry at the time. One article contained a detailed description and full-page drawing of a planimeter indicator Henry had invented for measuring the output of a steam engine. Henry wrote that "*under certain conditions of working, the instrument yielded extremely accurate results, but not so under all conditions, and so in the end I abandoned it.*" The article was a good example of Henry's integrity and demonstrated that while advancing in his profession, he was happy to publicise his failure in the interest of further progress.

Henry was involved in many commissions that he neatly recorded in his notebooks. One record details the boiler and steam engine he designed for the Cadbury factory at Bourneville. He was also involved in lift work, engine parts, truss calculations, girder design, and steam engine adaptations. Much like today, efficiency and economy of fuel consumption was a constant feature in Henry's work.

The eclectic needs of the time drove Henry's career in varied directions. His early projects involved him in church restoration and a proposed water tower at Bartley Green Reservoir in 1891. In 1892, he carried out the design and estimate for an electrical lighting fit out for a woollen mill in St Petersburg in Russia – his first export assignment. He also designed electrical organ-blowing apparatus for the Birmingham and Midland Institute in 1894, followed by foundations for the dynamo at a new Technical School in Birmingham in 1895.

Once Henry's client base had grown, he moved his office to 38 Bennetts Hill, Birmingham, and with the increasing pressure of work, he partnered with William Henry Thornberry Junior and, later, he invited his son Frederick M. Lea, to join the practice.

Henry was a successful Consulting Mechanical Engineer due to his scrupulous attention to detail, his uncanny flair for solving scientific and engineering problems and the respect he commanded from his fellow professionals. This was evident in his appointment to the Council of the Institution of Mechanical Engineers in 1899, having joined as a member back in 1860.



57

Chilled Castings The Engineer Dec 24 1880 p 474

For Chilled Rolls, chill 5/8 in depth

	parts	per ce
Hematite No 5	5	35·7
Lilleshall C.B.	5	35·7
Cleator White	4	28·6
		100

Enter tangentially so as to cause rotation of the metal. not too rapid or it will remove the wash of fine blacklead and pure clay from the chill. Heat to 160° to 200° before pouring.

For ditto to chill from 2" to 3" in depth

Cleator white	4	16·67
Brymbo	4	16·67
Lilleshall C.B	8	33·33
Hematite No 3	6	25·00
Pontypool No 3	2	8·33
		100·00

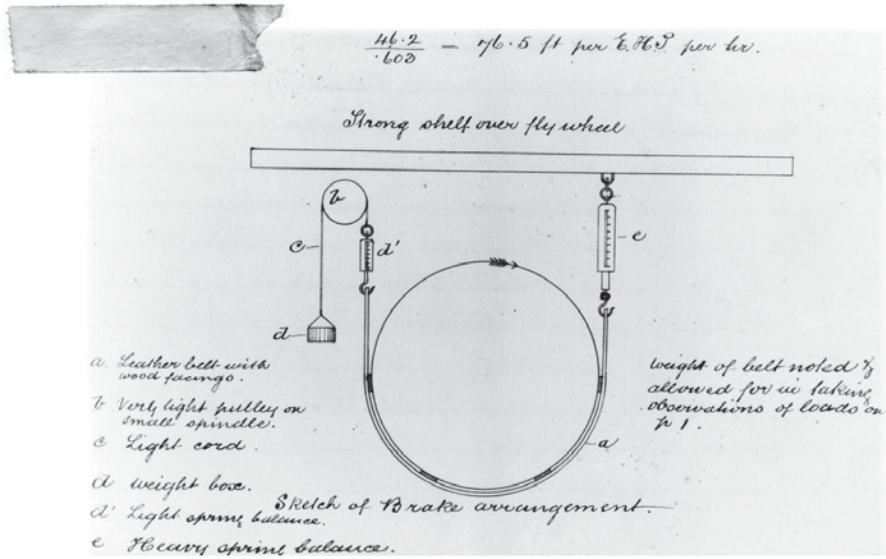
For Corn Mill Rolls abt 3'0 long × 12" dia Chilled abt 1" deep

	parts	per cent
Hematite No 5	10	35·1
Lilleshall C.B.	8	28·1
Cleator white	4	14·0
Brymbo	2½	8·8
Pontypool white	4	14·0
		100·0

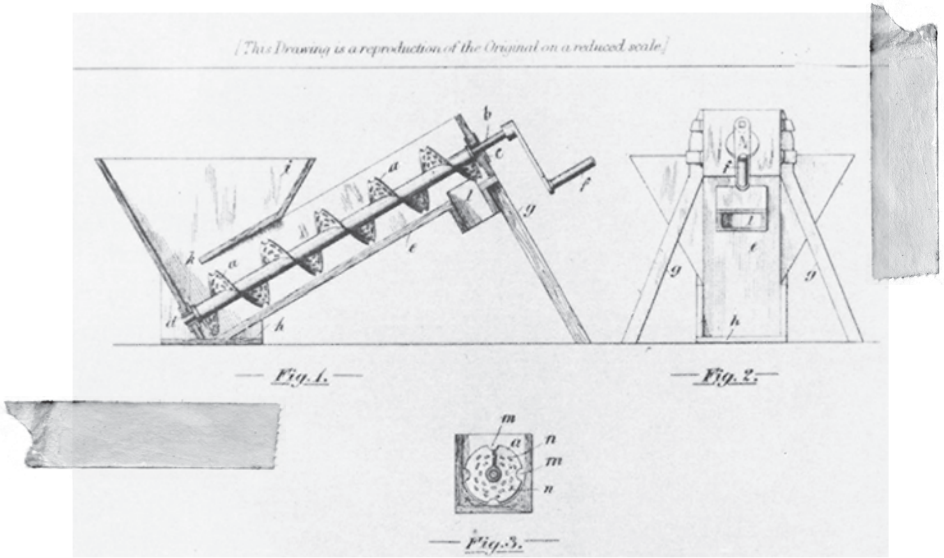
Another:

Hematite mottled	1	33⅓
Do No 5 strong	1	33⅓
Blaenavon or Pontypool CB	1	33⅓
		100·0

Pages from Henry Lea's notebooks (1880).



Henry Lea's invention consisted of submitting the grain to the action of a liquid continuously in a water-tight inclined vessel, having a semi-cylindrical bottom in which an archimedean feeding screw is rotated.

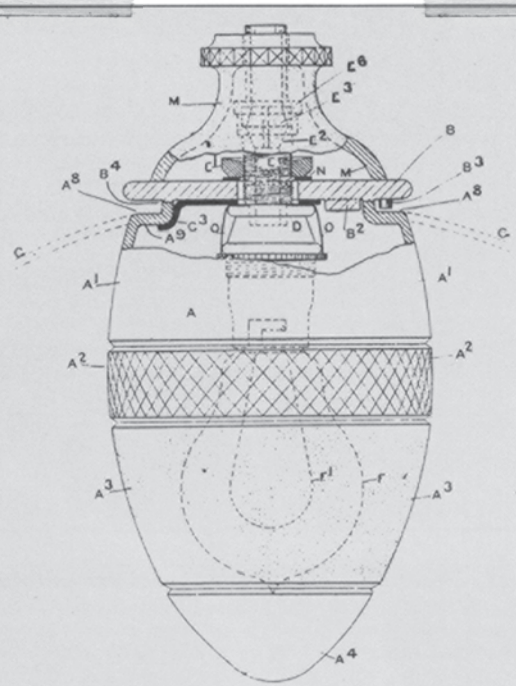


Steeping Grain; Patent specification n.13556 (1900)

Supplying Water to Birmingham

In 1891 Henry made a significant contribution to the way in which drinking water was supplied to large urban areas. By 1890 the local streams and artesian wells of Birmingham could no longer sustain the local community. It was recognised that in order for there to be enough pure water available for the next 50 years, it would need to be collected from further afield and from a region high enough to supply the town by gravity.

More than 80 miles to the west of the city, the streams in Radnorshire were seen to be an ideal water supply. To tackle the engineering challenge of transporting the water to central Birmingham Henry made the important decision to use three gas engines, stating that they were "*no more costly than steam and offered advantages in compactness, cleanliness, coolness, a minimum of attention and absence of coal, ashes, water, smoke and boiler repairs*." This decision proved to be a huge success. Not only did the gas engines herald the benefits that Henry had suggested, but they also provided constant high-pressure water to Birmingham for two shillings and sixpence per 1,000 gallons of water. This was an impressive achievement at the time.



LEA'S ORNAMENTAL GLOBES FOR INCANDESCENT LAMPS.

Messrs. Fowler, Lancaster and Co. are introducing a globe for enclosing incandescent lamps, which is represented in the adjoining figure. Of course, the object of such an attachment is to conceal the filament itself from the eye, while intercepting the light as little as possible. Both the globe and its cover are made entirely of glass, and there are no metallic rims or screws to work loose, the connection being of an elastic character. The method of attachment adopted relieves the electrical connections of the lamp-holder from the weight of the globe. So far as can be judged from the figure, this globe will probably strike most of our readers as being particularly well designed from the æsthetic point of view.

Globe designed by Henry Lea for enclosing incandescent lamps. Apart from concealing the filament itself from the eye whilst refracting the light for distribution effect, the globe received universal acclaim as being particularly well designed from a aesthetic point of view.

Globe designed by Henry Lea for enclosing incandescent lamps.

Lighting the Way in Electrical Engineering

Henry constantly evolved his consulting engineering skills to match the technical and scientific developments of the time. He was accepted into the Institution of Electrical Engineers (now the IET) in 1872, and was one of their very earliest members. He was an early pioneer in the rapidly expanding field of electrical lighting.

In 1882 he completed the lighting of Birmingham Town Hall, using revolutionary incandescent lamps. According to a report in *The Engineer* this was "*said to have been the first large public building to be illuminated in such a way.*"

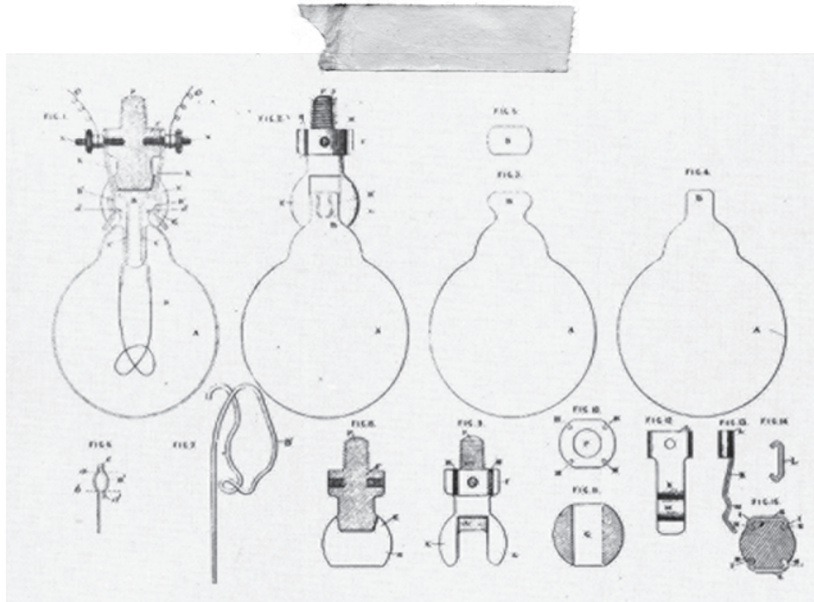
To mark the Birmingham Triennial Music Festival, held in the hall, Messrs R W Winfield, one of the largest manufacturers of gas fittings at the time, working with Rookes E Crompton, another early pioneer of electric lighting, offered to light the Music Festival at their own expense and asked Henry to supervise the arrangements for the installation. The event was a brilliant success, so much so that following the series of concerts, a special Saturday session was arranged for the general public to view the new lighting, at which Henry gave a public address to explain the phenomenon of electric lighting to a crowded Town Hall.

Some idea of how the general public viewed this new innovation in lighting at the time was seen in a report about the event in the *Birmingham Daily Post*.

> Mr H. Lea explained that electricity was not generated, as many supposed, by the friction of two parts of a machine rubbing against each other, but by causing a bundle of copper wires to revolve rapidly near the poles of a powerful magnet. The machines that were lighting the hall were situated at Messrs Winfield's Works in Cambridge Street, a quarter of a mile away. The lamps used were Swan incandescent lamps in which the electric current heated to a white heat a tiny thread of carbon within the globe, from which all air had been exhausted by an air pump. He caused the large lamp in front of the organ to be lit, after which, motive power was given to a machine in the centre of the hall and wood was sawn by means of a circular saw.

A commemorative booklet was published at the time, stating that in contrast to gas lighting which was hot and oppressive, the incandescent lamp was much cooler and therefore stood unrivalled. The musicians were delighted by the cooler temperature because their instruments, particularly the town hall organ, remained in tune for the entire concert and a member of the audience commented that during the Festival "*there has not been one case of fainting near me*." This resulted in a surge in public support in favour of the permanent installation of electric lighting at the hall, but this had to await the establishment of a power station in 1891 to supply the central area of Birmingham.

In 1884, Henry assisted Crompton's Chelsea Electricity Company in their application to Parliament to provide district lighting to a portion of the Parish of Chelsea, the first venture into district electrical lighting in Great Britain. Henry was subsequently



Henry Lea's invention for a safe and secure electric lamp fixing.

brought in to consult on the project and he was once again involved in a milestone in the evolution of lighting.

Henry undertook an increasing amount of electrical installations in almost all of the principal buildings in Birmingham. As the acknowledged expert, he was appointed by the Birmingham Corporation as the "*Electrical Advisor and Inspector to the Council*" on a salary of £150 per year. From his records and from newspaper reports at the time, the range and importance of the work he undertook is clear to see. For example, it was reported that in 1885 Henry worked on the lighting of the Prince of Wales Theatre and, the following year, the Theatre Royal, New Street, two prestigious buildings in Birmingham.

In September 1886, Henry was asked to supervise the installation of the lighting for the prestigious annual conference of the British Association, a group of the nation's leading scientists.

In 1887, Henry was engaged in the planning of engines, boilers and dynamos for the new Victoria Law Courts on Corporation Street, Birmingham, now a Grade I listed landmark building. This was followed in 1889 by the first of Henry's hospital projects, when he planned the lighting and heating for the new infirmary at Selly Oak.

At last, in 1891, the Birmingham Electric Supply Company formed and established a central generating station at Dale End, allowing an area in the centre of the town and its most important buildings to be served with mains electricity. Henry was appointed Inspector for all the work done by the Company. Several contractors were in competition and needed clear guidance, provided by Henry, to ensure that public safety was not compromised.

The Birmingham Gazette reported,

Mr Henry Lea, Consulting Engineer, in a report to the Electric Lighting Sub-Committee, makes the following recommendation: 'Overhead electric lines are not to be employed within the Borough of Birmingham excepting with the special consent of the Local Authority, and then only for a short period for ascertaining the extent of the demand in new districts prior to laying down the electric lines permanently underground'.

In 1891 the Birmingham Municipal Technical School was established to provide specialised technical training. The new building in Suffolk Street contained workshops and laboratories for chemistry, physics and metallurgy. Henry was an enthusiastic supporter of the project and provided all the circuitry, dynamos, heating and lighting for the building. The School later evolved into the University of Aston, one of the world's leading universities, where Henry's detailed plans are preserved today.

Over the following nine years, Henry worked on a number of important commissions: the lighting of the Birmingham Market Hall in 1894; electrification of the Martineau Organ in the Midland Institute in 1896; lighting for the King Edward's School in 1897; Carrs Lane Chapel in 1897, and St Martin's Church, Bull Ring in 1898.

Henry was regularly called upon to provide his expertise in the sensitive application of electrical wiring in ancient buildings. He worked on many of the stately homes and prominent ancient buildings in the Midlands, together with the Victorian mansions of prosperous businessmen such as Sir John Holder, owner of the Midland Brewery. He was also involved in a number of buildings of historical interest such as Aston Hall, Birmingham; Arbury Hall, Nuneaton; and Stoneleigh Abbey, Warwick. Other work at the time involved him in projects requiring expertise in mining gear, hospital work, and consultancy services for a new electric tram car system for Birmingham.

Electric Traction

Electric Traction was first seen in 1879 when Werner Siemens demonstrated a small electric locomotive at the Berlin Exhibition. As advisor to the Birmingham Council, Henry found himself at the forefront of the introduction of electric traction when he collaborated on an experimental system in July 1890. A new track was laid from the centre of the town to Bournbrook, a distance of three miles. The tramcars ran at 8 mph, the maximum speed allowed by the Board of Trade. The depot was at Bournbrook, where the accumulators were changed and re-charged. Early trials were a huge success. The brakes stopped the car within its own length and the cost per mile was four times less than for horse traction, a huge achievement for its time. *The Electrician*, 17 October 1890, reported,

The driver of one of the accumulator cars on the Bristol Road line last week lost control while descending an incline but the car was ultimately pulled up before any mishap occurred.

Birmingham University

Henry was closely associated with the development of university education in Birmingham. He was 35 years old when, in 1875, the foundation stone for the new "*Scientific College*" in Edmund Street was laid.

Aston Webb, a highly regarded Victorian architect, won the architectural competition to design the new university buildings and he chose Henry to work on this extensive project, with the power station the first building to be started. From it a subway six feet high and ten feet below ground was built to carry services to the main blocks of buildings. Blocks A, B and C, which were planned for electrical and mechanical engineering, mining and metallurgy, were built next. The Joseph Chamberlain memorial clock tower at Birmingham University still stands as a prominent landmark, known affectionately as Big Joe. Its design was inspired by the Mangia Tower in Sienna, which Chamberlain admired. It stands 325 feet high and the illumination of the clock faces, each more than 17 feet diameter, was supervised by Henry.

Following its opening by King Edward VII and Queen Alexandra on 7 July 1909, Henry was appointed a Life Governor of Birmingham University.

Mining Engineering

Henry had a particular interest in mining engineering. Early copies of the publication *The Mining Engineer* mention Henry and his work in this area, in particular his important contribution to tackling the serious dangers of drainage and the use of electric power in mines. He was heavily involved with the Institution of Mining Engineers and was elected President of the South Staffordshire and East Worcestershire branch in 1890, following his experimental investigations into improving electric lighting in mines and the use of electric safety lamps. In Henry's presidential address that same year, he tackled the severe problems caused by mine flooding. His intimate knowledge of the geographical structure of the Midlands Coalfield was essential in assessing this.

Prior to 1872, the pumping of water from mines was done by the engines of individual colliery owners and water that was pumped out of one pit in a congested area could overflow and flood its neighbour. The Mines Drainage Commissioners realised that a district approach covering both surface and underground drainage was required and in 1886 they called Henry in to advise them. Henry had to estimate the number and placing of pumping engines required to intercept water seeping underground from water courses, leaky canals and marl holes, in order to drain an extensive area. His scheme reduced the number of individual pit engines from 139 to 62 and he calculated that the cost of raising 25,000 gallons of water 100 feet was significantly cheaper with the new engines.

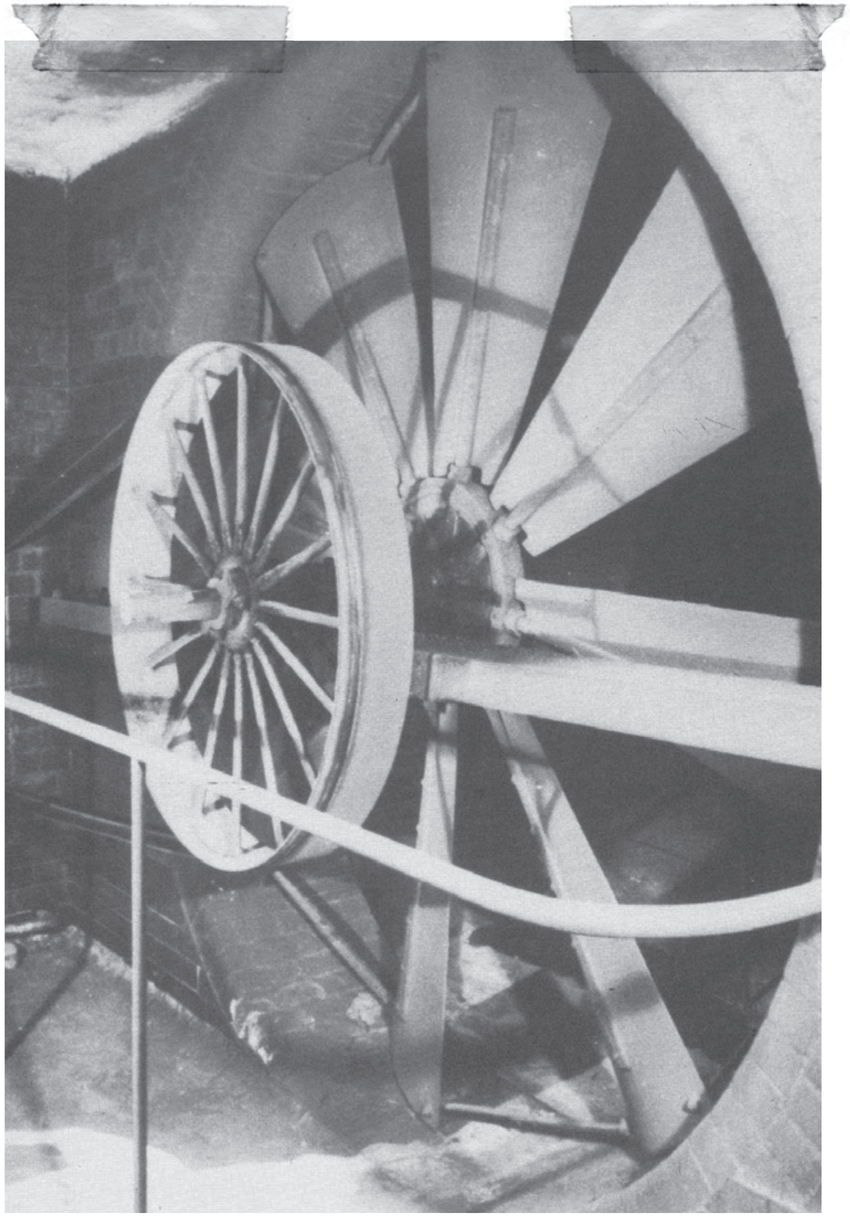
Hospital Ventilation

Henry made a remarkable contribution to the development of heating and ventilation techniques in hospitals. His visionary work in this area has had long-lasting and far-reaching implications with many of his innovations still used in the design of systems today.

Much of Henry's pioneering work in hospitals was carried out in collaboration with William Henman, a celebrated and much sought after architect of that era. Henman was one of a small group of architects who valued the contribution of engineering expertise both to building construction and to the control of the internal environment. Such a successful partnership was uncommon at that time. They met in 1879, when Henry supervised the heating and provision of deep well pumps for Henman's project at the Aston Union Council Offices and Library.

The Birmingham General Hospital

Henman won the architectural competition to design the Birmingham General Hospital building and wanted Henry to be part of the team. The building had been designed on the basis of natural ventilation when Sir John Holder, Chairman of The Building Committee, received a letter from a friend who asked him to see a recently completed hospital in Scotland. The Glasgow Royal Infirmary, that had been ventilated by a *plenum system*, a form of mechanical ventilation that better separated



The 8ft. fan for plenum ventilation at Birmingham General Hospital (1893).

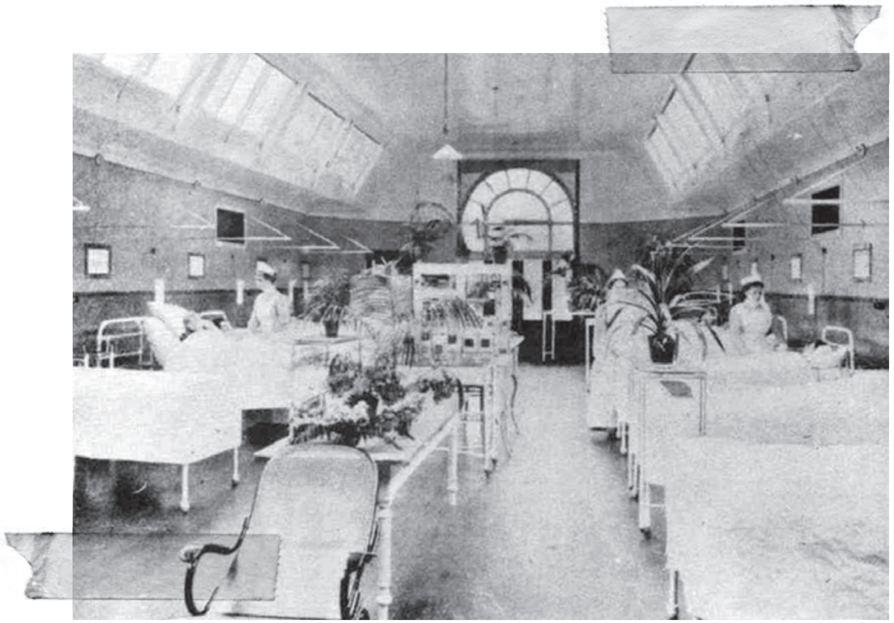
fresh supply air from contaminated air and therefore produced a cleaner environment.

Holder returned from Glasgow filled with enthusiasm for the new method. He called a meeting of the committee and took five members on a second visit. They noted that the wards, which normally provided for 160 patients, could now accommodate 25 percent more beds without detriment to the air quality, owing to more efficient ventilation. When they got back, they decided to adopt the plenum system for the Birmingham hospital. This was an enormous challenge due to the need to adapt the naturally ventilated design to incorporate the requirements of the new mechanical system.

The windows were all permanently closed, with double doors fitted to the entrances. In Henry's notebooks the air entering the hospital was drawn down shafts outside the building by large fans eight feet in diameter, through moistened screens to filter suspended impurities. According to Henry's notebooks the fans maintained a steady change of air to the wards of between seven and ten times per hour. The temperatures in the wards remained at a level between 60 and 62 degrees Fahrenheit (15.5-16.5°C) day and night, winter or summer, with the option of raising it to 72 degrees (22 °C) if required. Henry wrote many pages of painstaking calculations showing relationships between fan revolutions, volume and velocity of air, direction of underground ducting, generator power and wiring circuits. The capacity of the buildings was two million cubic feet (57,000m^3), within which twenty million cubic feet of air was changed every hour (157m^3 per second). Both Henman and Henry were well aware that, technically, the hospital had been an exercise in compromise because of the need to incorporate the plenum system into the existing design, but the experience they had gained convinced them that this system could revolutionise hospital design for the future.

The Royal Victoria Hospital, Belfast

Following on from the success of the Birmingham General Hospital, Henman was approached directly to provide plans for an entirely new style of hospital for Belfast based on his revolutionary designs. Henman insisted on Henry joining the



A Royal Victorian Hospital ward with closed clerestory windows and plenum ducts concealed within walls.

design team and on 20 December 1898, the publication entitled *The Architect* reported that he had "*accepted the commission together with Mr Henry Lea MInstCE as Consulting Engineer.*" Years later, in 1969, the architectural critic, Professor Reyner Banham, stated that the building "*is extremely modern and ahead of its time in its environmental controls. Incredibly the Royal Victoria Hospital was the first major building to be air-conditioned for human comfort. The importance of the hospital in the history of architecture lies in its total adaptation in section and plan to the environmental system employed.*"

The general design of the hospital was planned in two distinct sections, according to their environmental needs. The section for the sick, comprising theatres and seventeen wards, was located within a dedicated single storey plenum ventilated sealed block. The administration section was located within naturally ventilated tall buildings. A very large brick lined air duct nine feet wide and 443 feet long ran beneath the main corridor. These spacious dimensions were necessary according to Henry's calculations in order to provide the required seven changes of air per hour in winter and ten changes per hour in summer to the patients' side of the hospital. There were two driving fans, each over nine feet in diameter, though normally only one was needed. Henry had arranged for all essential equipment to be in duplicate to allow for repair, rest and cleaning. He arranged for the fans to be driven by a steam engine, the exhaust steam from which was used for heating water for domestic use, thus making substantial savings in the cost of electricity.

Professor Banham wrote that "*the duct is one of the most monumental in the history of environmental engineering … all the wards are carried on an elaborate system of arcaded under-crofts*."

Air conditioning is usually defined as controlling heating, ventilation, cleanliness and humidification of air. The control of humidity at the Royal Victoria Hospital whilst revolutionary at the time was crude by modern standards. Based on manually adjusting the flow of water over the humidifying screens, the hospital can justifiably claim to be one of the first, and possibly the first, building in the world to have been air-conditioned for human comfort.

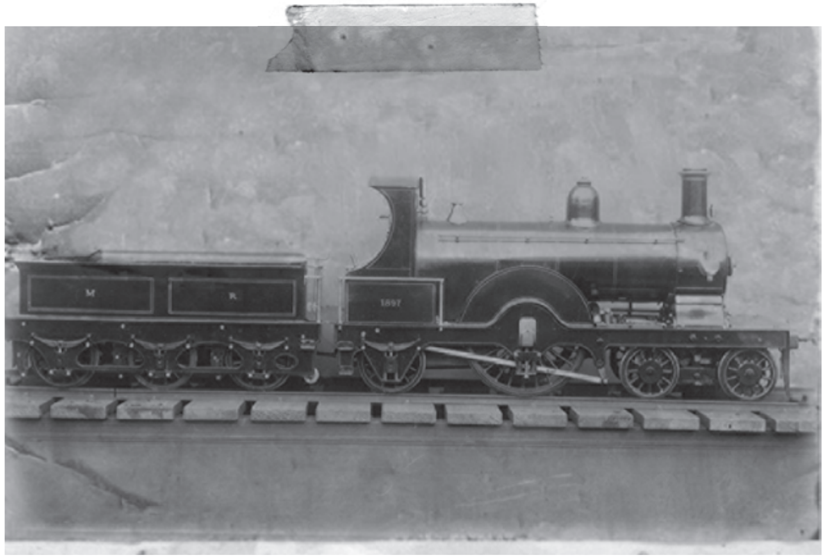
The hospital created quite a stir in medical and architectural circles and Henry's designs were seen to be strongly controversial at the time. The rival merits of natural versus artificial ventilation were hotly debated. In 1980 the hospital was subject to a visit by the Department of Health and Social Security's Low Energy Hospital Team. They were assessing the buildings in light of modern medical practice and reported that the plenum ventilation "*was still working as originally designed*."

The present hospital engineer thought that "*the basic simplicity of the system was its greatest advantage, the maintenance was probably no more of a problem than in newer buildings*." This was incredible given it was over 80 years after it was originally designed.

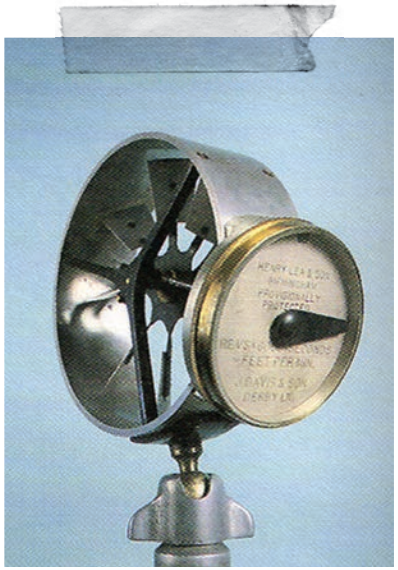
The Inventions of Henry Lea

In spite of his extensive commitments, Henry made an astonishing 21 patent registrations during his life. Never a man to waste time and with an enquiring mind and innovative approach, his patent applications are in themselves a record of the rapid advancement in technology during "the age of improvement" ranging from improvements to steam engines in 1876 through to designs for electric light fittings and controls for early internal combustion engines. Henry's fascination with and commitment to invention continued throughout his life, with his final patent application made in 1911, one year before his death.

The letters, patent and seal of Henry Lea's invention of improvements to taps or valves.



Henry Lea's model railway locomotive. (1898)



Henry Lea patents the integration of an indicating dial to the anemometer, used to measure air speed. (1911)

Whilst many of Henry's inventions have since been surpassed, it was his early insight into how technology would develop that marked him as a true pioneer. His designs for the early angle-poise lamp and the application of electrical power to domestic equipment such as sewing machines were fundamental steps in the progress towards their modern counterparts. This longevity in terms of the application of Henry's designs is what truly marks his influence not only on the built environment, but upon the broad range of engineering disciplines in which Henry Lea worked in.

At home, his great hobby was model locomotives and railways. The model railway in his garden was well-known. In fact, the single-driver Midland Railway model locomotive, which he built himself, was shown at many exhibitions and still exists to this day.

Edwin Hoare (1887-1957)

Hoare Lea: From 1912 to 2012

Following the death of Henry in July 1912, aged 74, Frederick M. Lea, Henry's son and long-standing principal assistant took control of the firm. By this time, Frederick had already amassed an impressive amount of experience in the field, allowing him to successfully continue the ground-breaking work of his father.

Frederick's own career had begun after the completion of his studies at Marston Science College in Birmingham in 1893. In June of that year, Frederick travelled to Russia to assist in the design of an electrical lighting installation at Messrs Thornton's Woollen Mills in St. Petersburg – perhaps one of the earliest known international projects for the firm. Following his return to the UK in October 1893, Frederick worked in a variety of roles, allowing him to gain early practical experience. In 1897, he returned to his father's office after completing an electrical engineering course at Owen's College, Manchester.

In keeping with the tradition set by his father, Frederick brought his son, Donald, into the firm in 1938. Unfortunately, Frederick died unexpectedly the following year, leaving control of the firm to Donald, aged just 26. In light of Donald's age and level of experience, he made the decision to amalgamate the firm with that of Edwin S. Hoare, an experienced and entrepreneurial engineer based in Bristol, to form Hoare, Lea and Partners.

Edwin Salter Hoare commenced practice as a Consulting Engineer following time spent in the military during World War I. Having previously worked as an engineer for a firm of laundry equipment manufacturers, his portfolio grew rapidly to encompass steam-raising plant for heating, and, later, hospital work.

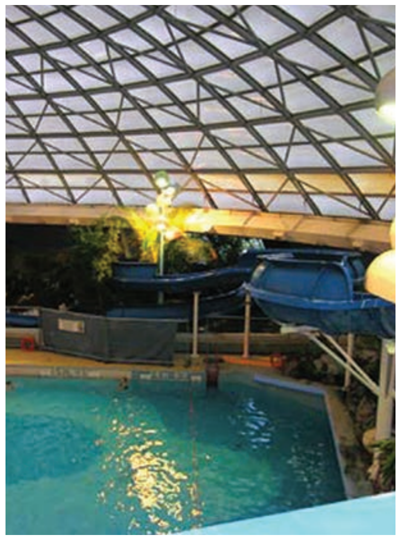
Shortly after the merger of the two firms, the outbreak of World War II saw several staff leave to join the armed forces. The on-going military activity radically affected the direction of the practice, with Hoare Lea taking on a great deal of design work for the War Office, including manufacturing plants, munitions factories and the design of airfields. The firm also provided engineering design services as part of the provision of emergency housing for the homeless following the bombings of Liverpool in 1941. During the war years, the firm briefly became a multi-disciplinary practice, employing architects, civil, structural, mechanical and electrical engineers, before later returning to its core focus of mechanical, electrical and public health design.

The post war years saw new growth for the firm. As well as continuing to work on government projects as a result of the work undertaken during the war, the partnership began to take on more projects further afield. Edwin Hoare's extensive travels helped to secure foreign work, including a Rayon facility in Travancore in 1945. Staffing levels and overseas work increased throughout the 1950s, and the firm opened offices in the Middle East, North Africa and Nigeria.

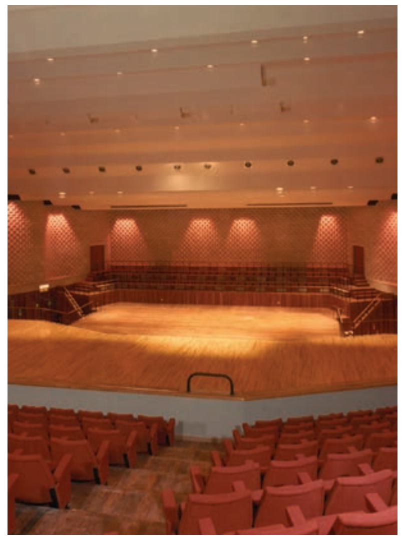
Edwin Hoare died in 1957 at the age of 69, but his efforts during the previous 20 years had already made a significant contribution to the development, structure, size and direction of the firm. Following Edwin's death, Donald became the

new Senior Partner of the firm that had been founded by his grandfather. In the 1960s, the firm worked extensively on large-scale public buildings and commercial and industrial projects.

By 1973 Donald, now in his sixties, was beginning to reduce his responsibilities as the senior equity partner. By the mid-70s, the new Senior Partners Stephen Edwards and Alan Knight recognised that the future success of Hoare Lea was dependent on graduate recruitment, rather than the technician level intake that was common at the time. An influx of graduates helped Hoare Lea to grow and be viewed as a progressive place to work, offering challenging projects and a partnership structure where effort was recognised and rewarded. Many of the graduates joined from Bath University School of Architecture and Building Engineering where Stephen Edwards had worked



Oasis Leisure Centre, Swindon. (1976)



Poole's Centre for the Arts. (1978)

with Ted Happold to create an environment where mechanical, electrical and public health engineers and structural engineers were taught alongside architects.

At the same time, Hoare Lea began to work on a much wider variety of innovative projects. Energy conservation has always been of key concern to Hoare Lea. In Henry's original letter announcing his commencement in practice, he stated that he intended to "ensure the preservation of smoke and a greater economy in the expenditure of fuel." During the 1970s, the firm undertook numerous large scale building projects involving low energy use systems, including heat recovery and district heating, whilst developing specialist skills and expertise in the use of alternative sources of energy, such as solar power, heat pumps and geothermal. The firm became more involved in

Grand Hotel, Brighton. (1984)

Jaguar's Engineering Centre, Whitley. (1987)

research and development, and won a commission from the Government's Energy and Technology Support Unit (ETSU) at Harwell as lead consultant on a project concerned with the utilisation of geothermal energy in the UK.

By 1982, the firm had expanded further, and now employed over 250 people nationwide in seven offices. Hoare Lea was working extensively in Europe, the Middle East and Far East, Africa and South America. A brochure from that time states that despite the geographical spread of the regional offices, the firm operated as a unified practice – an approach that is at the core of the firm today.

From the 80s onwards, the practice had cemented its reputation as having a collaborative approach with staff who could contribute effectively to the wider design team. New specialist groups were started including acoustics and lighting and in particular research and development which, under Terry Wyatt, was responsible for developing ground-breaking technologies such as chilled ceilings, chilled beams and displacement ventilation which up until then had not been used in the UK. Hoare Lea continued to work on large scale, award-winning projects, attracting numerous industry accolades, including winning the Large Consultancy of the Year at the Building Services Awards five times.

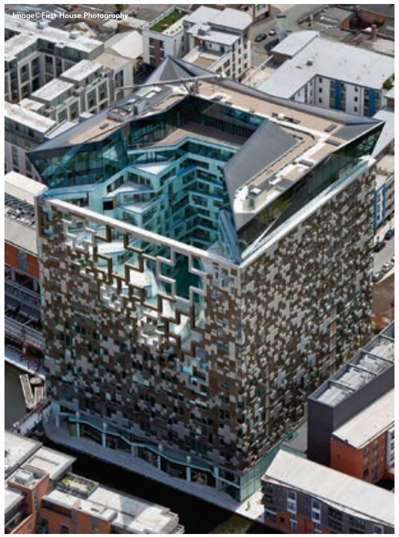
Hoare Lea combines technical excellence and a reputation for delivery with a creative and progressive approach. Experts in engineering design for the built environment, the firm works on projects of all sizes, and across all sectors, from modest individual buildings to the master planning and regeneration of major mixed use schemes.

Recently, the firm has been at the forefront of the use of Building Information Modelling (BIM). As an early adopter, Hoare Lea has used BIM on a variety of projects and chairs the CIBSE BIM panel. Between 2011 and 2012, the firm won over 40 industry awards and was voted amongst the top building services engineers to work with by Building Design Magazine, as well as being featured in Building Magazine's Good Employer Guide. The firm remains at the forefront of research into sustainability and advises the UK Government, the EU and other key influencers.

Hoare Lea's success is generated by its people, both Partners and employees. Founded in 1862 by one remarkable man, Hoare Lea has grown to become the largest practice of its kind in the United Kingdom and has a growing international presence.

MOD Abbey Wood, Bristol. (1996)

Millennium Stadium, Cardiff. (1999)



The Cube, Birmingham. (2010)

One New Change, London. (2010)

Cover Image: Letter announcing Henry Lea as a Consulting Mechanical Engineer (1862).

Henry Lea begs leave respe
of many Gentlemen well acquainted w
has commenced practice as Consulting M
He takes this opportunity to inform his fri
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ready to undertake the examination