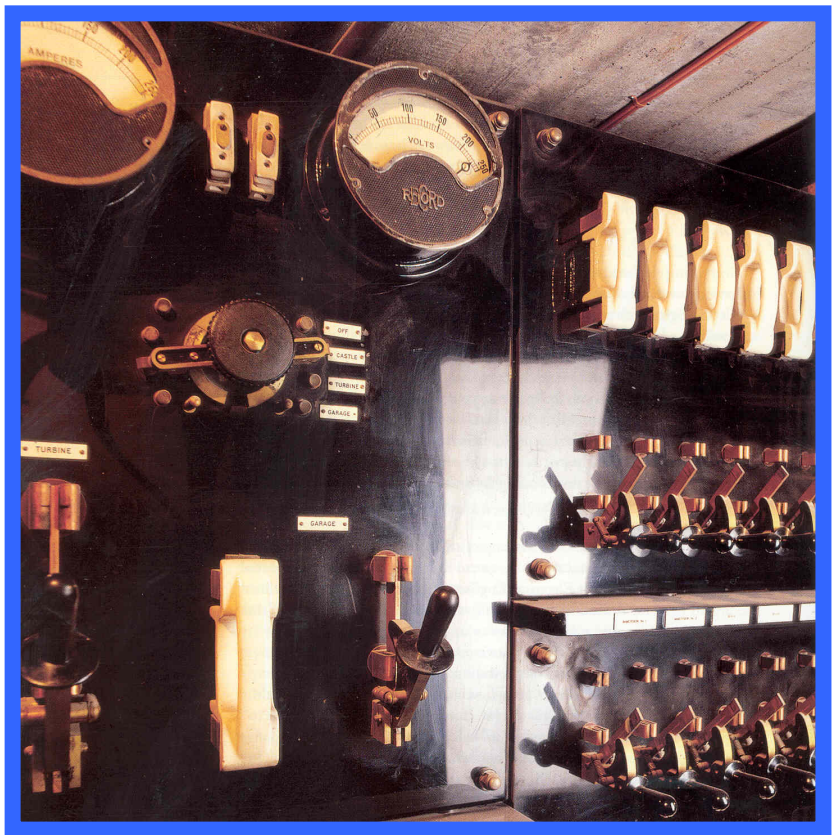
# Building Engineering Services
# HERITAGE REVISITED
## Part 1

**Brian Roberts with Frank Ferris**
**and the CIBSE Heritage Group**




**Switchboard at Castle Drogo c.1930**
[National Trust]

## ST BARNABAS, EPSOM, SURREY


**Grundy stove at St Barnabas in Epsom**

Warm air heating stove manufactured by John Grundy Ltd, London (Islington) and Tyldesley (near Manchester). Installed in St Barnabas Church, Temple Way, Epsom, Surrey, c.1920. Later converted to oil-firing. The stove was removed and scrapped in November 2003. John Grundy was the first President of the Institution of Heating & Ventilating Engineers (IHVE) in 1898. His son, Herbert, was President in 1915.

***Information & photo John K Love Associates***
***and Philip Morphy of Thomas Ford & Partners***

**Ripon Prison**

This part of Ripon Prison dates from around 1816. However, it seems more likely that the boiler dates from the time of rebuilding work around 1866

# INTRODUCTION

**This is a follow-up publication to the book *Building Services Heritage* introduced at the Edinburgh CIBSE/ASHRAE Conference in September 2003. Like its predecessor, it features some of the historic building engineering services discovered by the CIBSE Heritage Group and shows the works carried out by some of our industry pioneers.**

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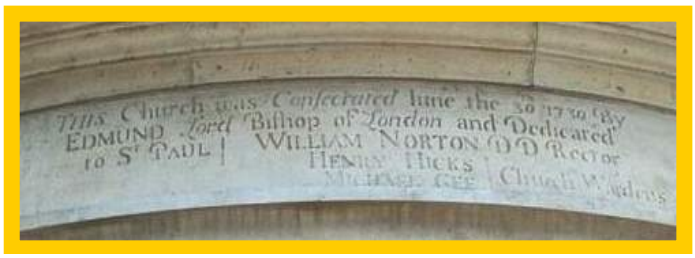
## ST PAUL'S, DEPTFORD



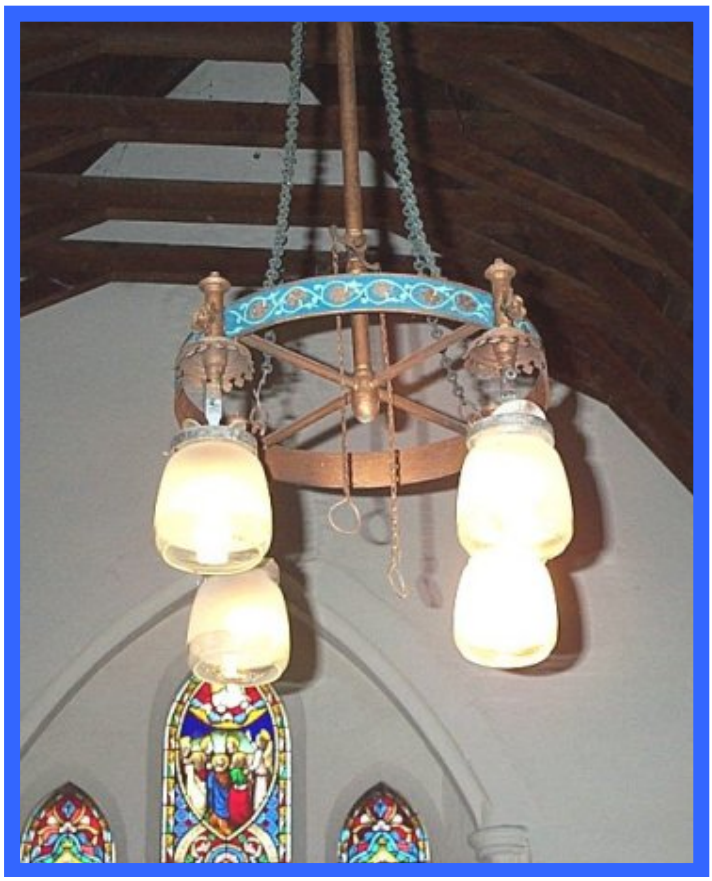

**Grundy stove**

**The Grundy Stove**

St Paul's Deptford is one of the Commissioners' Act of 1711 churches, built with funds from a tax upon coal coming into the Port of London. The aim was to replace the churches destroyed in the great fire of 1666. Fifty were planned, but only 12 were built. St Paul, begun in 1713, was built in Baroque style to the plans of Thomas Archer (a student of Christopher Wren). John Whichcord carried out the first heating in 1856. The date when the Grundy stove was installed is unknown. It sits in a deep pit the top of which is covered by cast-iron gratings to allow the heat from the stove and flues to rise into and warm the church. Originally solid-fuel fired the stove was later converted to oil-firing. The stove is of large size and extremely heavy with four finned annular sections fitted together with sealed joints. The flue outlet pipes are routed across the top of the pit to extract as much useful heat as possible. The addition at some time of a wet heating system in the church must cast doubt on the effectiveness of this Grundy stove which, as part of the renovation of the church, is being retained as a rare example of Victorian engineering craftsmanship.

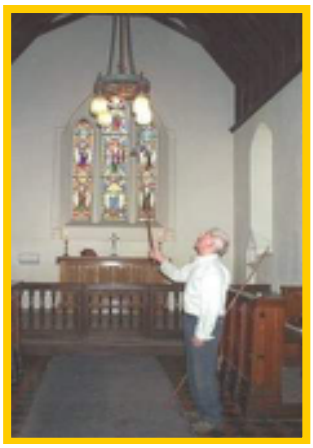
***Survey & photos Frank Ferris with assistance from Brough Skingley & David Drewe (both Historic England) and John Barnes. Thanks go to Brian Lofthouse of Thomas Ford & Partners David Bailey of BJP and to Dean Richardson & Kevin Holfield of Kingswood Construction (London) Ltd***

## ST PETER'S, FUGGLESTONE, WILTSHIRE



**4-lamp hanging pendant**

The small church of St Peter in Fugglestone, of ashlar and rubble construction, dates from the 13th century. The small village of Fugglestone does not show on most maps and but for the church the village would have disappeared. Lepers from the nearby hospital used the church for worship during the 1200s. Given a Victorian restoration in 1848, St Peter's is now locked in a time warp of engineering history, as due to its small size it has never been converted to electricity. It still has and still uses the original Victorian gas lighting. During wintertime services have to be held in the afternoon, as the gas lighting is not sufficient during the hours of darkness. The church retains both its balconies (unusual after restoration) and the original box pews.



**Churchwarden lighting the gas mantles in time for the Service**

**Wall bracket lamp**

**Balcony and ground floor box pews**

***Survey & photos Frank Ferris***

## ALL SAINTS, LLANELLI, Carmarthenshire

**3 expansion pipes**

**Piping around column**


**Installer's plaque**
Musgrave & Co Limited
Belfast

***Survey & photos Frank Ferris***

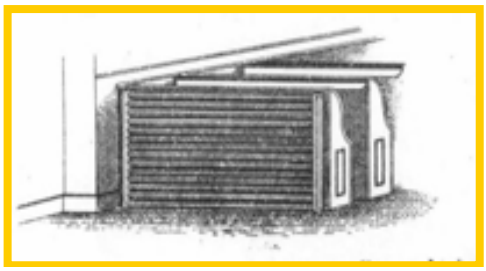
**Perkins' brickwork furnace, now oil-fired**

The original heating is believed to have been provided by means of a warm air stove system, evidence of which can be seen from the old bricked-up flue in the furnace room and from the gratings in the church floor. The church was enlarged in 1887, when the Perkins's high-pressure hot water heating system was probably installed, Musgrave of Belfast being the contractor. The system has 5 circuits, the returns being visible in the above photograph, making it the largest system of this type so far discovered by the Heritage Group. The system is still in use today. It is interesting to note the skill and craftsmanship of the Victorian artisan, an example of which is the double row of pipework bent and formed to follow the radius of a circular column (left) without the use of hydraulic bending equipment.

## ST MICHAEL'S, HIGHWORTH, WILTSHIRE

**10-row single bank heating coil**
With Gothic styling on each end header box

The church dates from the 13th century, a major restoration being carried out by the Victorians in 1861-62. The size and number of floor gratings in the side aisles indicates that a warm air stove once provided the heating and formed part of the restoration works. The present hot water heating systems dates from around 1895. Documents discovered at the Wiltshire Record Office in Trowbridge show that the firm of Skinner & Board of Bristol installed the heating. There are a variety of sizes of pipe coils and, interestingly, many unusual cast-iron pipe fittings, which appear to have been purpose made to suit the structural layout of the church and the arrangement of pews.



**Heating coil from Skinner & Board brochure**


**The Artisans who fitted the works**

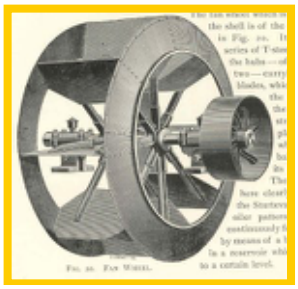
**Warm air floor grille**

**Examples of special cast-iron pipe fittings**

***Survey & photos Frank Ferris***

**Frank Ashwell**
1855-96
Set up in business in Leicester 1879. Took Nesbit into partnership in 1892. Company was a founding member of HVCA. Ceased trading 1969

**David Mein Nesbit**
1855-1929
President IHVE, 1900. First President HVCA, 1904-9. Developed *Nuvacuumette, Nutomatic* & *Nucalometer* steam systems and associated controls.



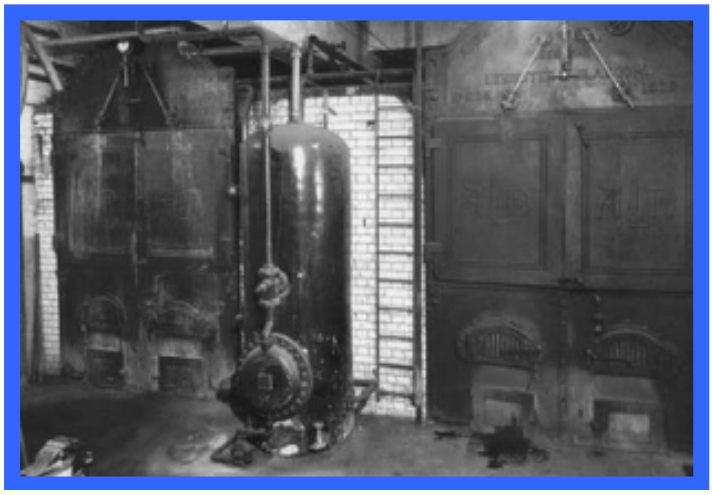
**Sturtevant paddle-bladed impeller** 1906

***Survey & photos Frank Ferris***

## METHODIST CENTRAL HALL, WESTMINSTER


The Methodist Central Hall in Westminster (now a Grade II listed building) was originally funded by individual donations, each of one guinea, and built as a lasting tribute to the memory of, and to mark the centenary of the death of John Wesley (1703-91), the founder of Wesleyan Methodism. Some £250,000 was allocated from the fund to cover the cost of building. The idea for the Hall came in 1898 with the building works starting soon after. It was constructed on the site of the demolished Royal Aquarium of 1876 for which W W Phipson had designed the heating. The designer and contractor for the heating and ventilation of the Hall was Ashwell & Nesbit. At the time of the Heritage Group survey the building was still heated by the original *Nuvacuumette* vacuum steam system, serving cast-iron radiators in most of the ancillary rooms. Heating and ventilation for the main Hall was by a warm air plenum system using two supply fans and one extract fan, all being of double inlet, paddle-bladed, centrifugal design. The two supply fans (possibly of Sturtevant manufacture) are unusual in that the casing is a three-quarter housing on a concrete plinth. The fans appear to have been delivered to site in sections, which were bolted together in-situ. The ventilation air is distributed around the building in builderswork ducts. One supply fan in a roof plant room passes air through a steam heater battery into the large ceiling void over the main Hall, from where it is discharged at ceiling level. The other supply fan, located in the basement, distributes heated air into the void above the ground floor ceiling, which then rises through two vertical shafts to the main Hall where it is discharged at high level.

**The Main Hall**

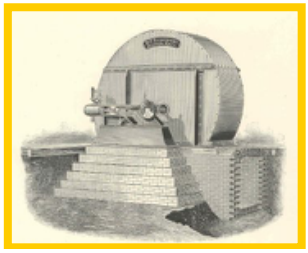


**The two Ashwell & Nesbit solid fuel steam boilers**
Installed 1909, photographed in 1967 before replacement by oil-fired boiler plant

**Supply fan in roof plant room**

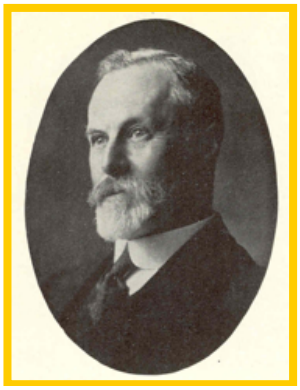
**Steam heater battery**
Cast-iron, double row, two-tier arrangement within main Hall ceiling void

**¾ centrifugal fan**



**¾ fan on plinth**
Sturtevant 1906

# LIVERPOOL ANGLICAN CATHEDRAL



**Wm Nelson Haden**
1859-1946


**Chas Ingham Haden**
1863-1947

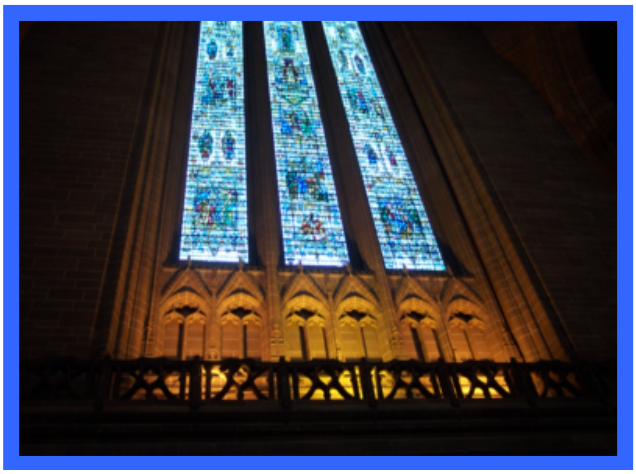

**Haden Specification Heating & Ventilation Liverpool Cathedral**
1924

The Liverpool Cathedral Church of Christ is built on St James' Mount and visible for many miles around. The decision to build was that of Bishop Francis James Chavasse in 1901. After an open competition, a design by an unknown 22-year-old architect was chosen. His name was (Sir) Giles Gilbert Scott. [Scott worked on the cathedral until his death in 1960, even longer than Wren worked on St Paul's.] King Edward VII laid the foundation stone in 1907. The main parts of the cathedral were consecrated in 1924, but the first service in the completed Cathedral Space was not until 1940. This, the largest cathedral in Britain, was not fully completed until 1978. The building is 619 ft long and covers over 100,000 sq ft. The height of the nave vault is 120 ft, while that of the tower is 331 ft.

The planned heating underwent changes over the early years. As G Nelson Haden was later to recount to the Institution of Heating & Ventilation Engineers (IHVE), the original Edwardian proposal was "to heat the cathedral by low pressure hot water radiators and the direct introduction and recirculation of warm air. In 1919 a new system was suggested...Almost the whole floor was heated by a system of closed warm-air ducts" (adopting the principle used by the Romans in their hypocaust). As a precaution big banks of radiators were installed in entrances and under the clerestory windows "to prevent the usual anticipated down-draught." G N Haden also described the tests he carried out in 1921, the most unusual feature of which was the use of "big hydrogen balloons on fine silk," when he discovered the dramatic effects of draughts caused by wind on the stained glass windows."

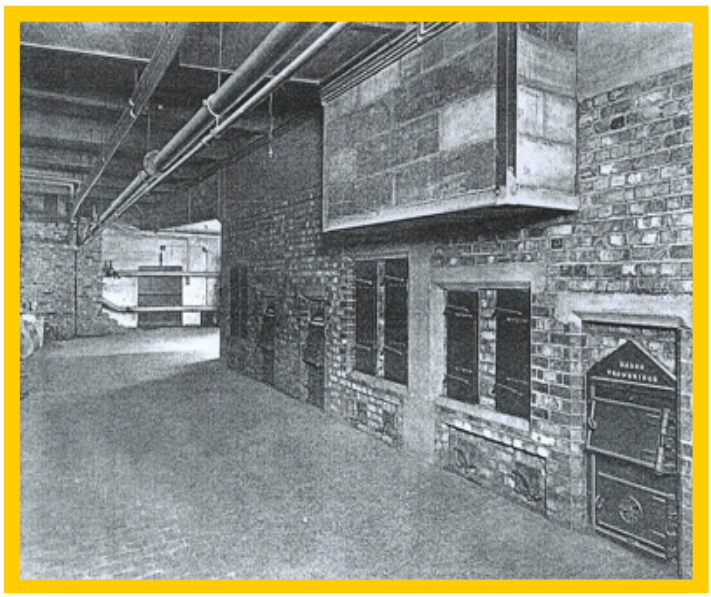
*Right*
**View from roof**
RC Cathedral (centre)

***Survey & colour photos***
***Mike Barber &***
***Neil Sturrock***

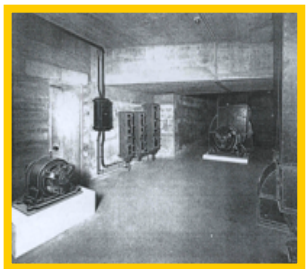


**The interior**

**The Cathedral**
from Haden brochure



**Original warm air apparatus** with Haden stove



**Original fan chamber**

**West End Floor Heating Fan starter**
Brookhirst

**Centrifugal fan set**

**Oil-firing conversion**
Haden 1931

## CHIRK CASTLE, CLYWD, WALES

**Gasolier**
Converted to electricity

**Servant's callboard**
Drake & Gorham

**Domestic boiler**

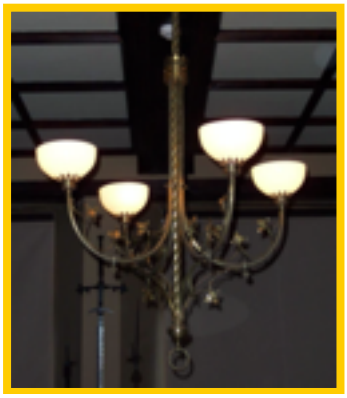

**Nameplate** W J Smith

**Gasworks ruins**

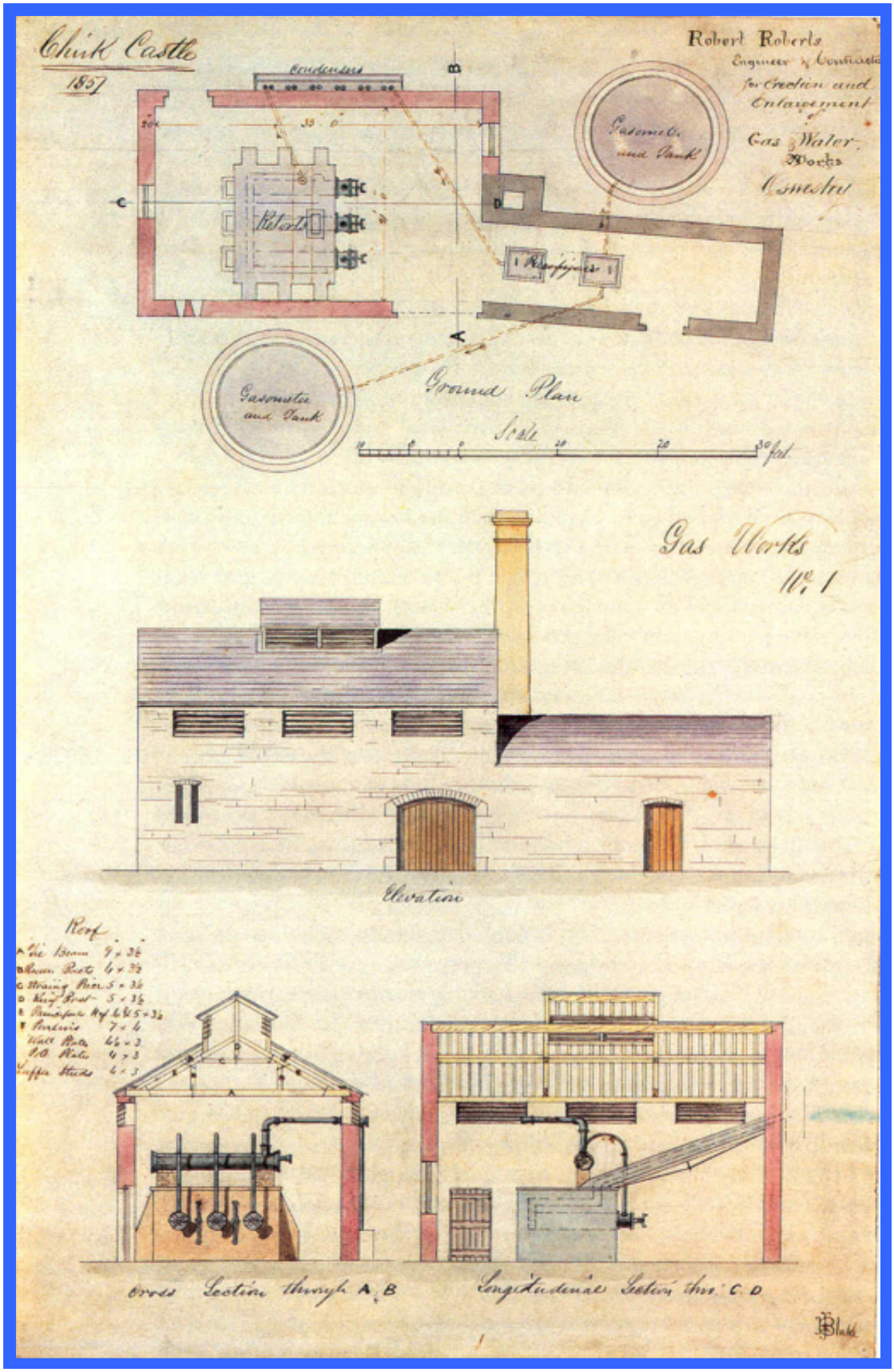
***Survey & photos Mike Barber & Frank Ferris***

Chirk Castle, near Wrexham, is a magnificent Marcher fortress completed in 1310. It was built for Roger Mortimer, Justice of North Wales for Edward I. In 1563, Queen Elizabeth I gave the Lordship to her favourite Robert Dudley, Earl of Leicester. It passed to Lord St John of Bletso who in 1595 sold it to Sir Thomas Myddelton for £5000. His descendants continue to live in part of the castle today. Built on a rectangular plan, it has a massive drum tower at each corner. The first central heating appears to have been accomplished by a warm air system serving the principal rooms, but only blocked-off floor and wall grilles remain. The present hot water heating system employs radiators suggestive of a date between the two World Wars. There is a nameboard C Seward & Co Ltd, heating engineers of Chester. Their origins can be traced back to Abraham Seward, who in 1797 was appointed Tinsmith Worker in Ordinary to King George III. Chirk had its own plant for manufacturing town's gas installed in 1857, but only the ruins remain. There are various gas chandeliers now converted to electricity. The castle later had a dc generating plant powered by a water turbine, thought to be c.1900. The electrical contractor was the Manchester office of Drake & Gorham and there are remains of a marble switchboard with rewirable fuses and knifeblade switches. There is also a Drake & Gorham electric bell call system with two annunciator panels, a relay panel, and associated bell pushes. There are the remains of a vertical domestic hws boiler in the laundry, but the nameplate is illegible. The kitchen contains a "Jack Fire" and bread oven, both by W J Smith, Pont Street, Belgrave Sq, WC.

**Marble switchboard**
Drake & Gorham



**Gasolier**
A W N Pugin




**The Gas Works, Chirk Castle** 1857
The engineer was Robert Roberts

Drawing National Trust (Myddelton Family)

## POWIS CASTLE, POWYS, WALES

**Radiator plug**
American Radiator Co

**Radiator valve**
Richard Crittall

**Corner radiator**
Beeston pattern

**Heater enclosure**

Once a medieval castle, the oldest part of this Welsh stronghold possibly dates back to around 1200. It came into the hands of Sir Edward Herbert in 1578. During the Civil War it was captured and garrisoned by Parliamentarian forces, necessitating extensive rebuilding and refurbishment after the Restoration in 1660. The second earl, George Herbert, had extensive building work carried out from 1772, but was deeply in debt when he died in 1801. Fortunately his sister had married the son of Clive of India, and the family fortune allowed the castle to be further refurbished in 1815-18 and properly maintained. The architect G F Bodley carried out a well-judged restoration from 1902. Powis Castle was bequeathed to the National Trust in 1952. The Heritage Group survey found that open fires apparently heated the property until the remodelling by Bodley, when a low-pressure hot water heating system was installed by Richard Crittall & Company, established in 1884 (since 1973 part of Crown House). Some radiators bear an ARC (American Radiator Co) monogram; others have the Crittall name on the handwheel of the radiator valve. Both tubular radiators and models by the American Radiator Company were found. Artificial lighting was originally by oil lamps and candles until the castle switched to electric lighting, fed from its own generator (now removed). Examples of wooden cable trunking still exist. A Haden warm air stove, in extremely poor and dilapidated condition, was discovered in the Orangery. (A search of Haden records reveal that a stove and a hot water boiler were supplied to Earl Powis in 1842).

**Stove** Haden

**Splash plate** Musgrave

***Survey & photos***
***Mike Barber & Frank Ferris***


**"Ediros" WC** John Bolding

**Corner radiator top**


**Bath** Doulton & Co

**Servants' call board**

**Extract Fan** Musgrave with Verity motor


**Fire hydrant** Shand Mason

**Fan speed control** Verity

## PENRHYN CASTLE Gwynedd, WALES

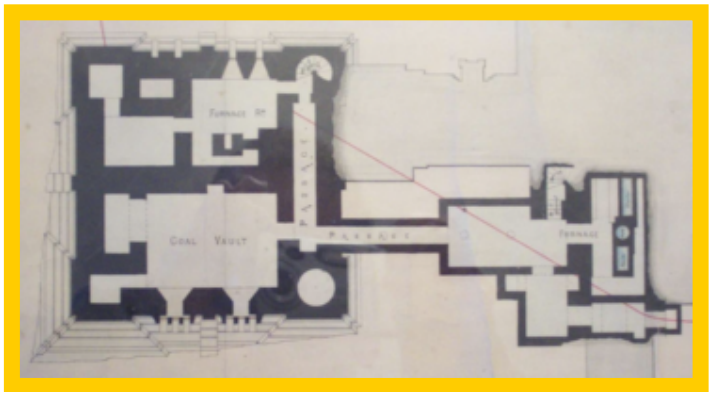
**Ornamental stove**

**Sectional radiator**
Beeston or Wm Graham

**Curved sectional radiator** Haden


**Radiator plug**
Haden Trowbridge

***Survey & photos Mike Barber & Frank Ferris***



**Plan showing furnace rooms & coal vault**

In 1808, George Hay Dawkins Pennant inherited the Penrhyn estate and a vast fortune from his great-uncle Richard Pennant, Baron Penrhyn. It had belonged to Richard's wife, formerly Anne Warburton, a descendant of John Williams, Archbishop of York, who bought the estate in the early 17th century. Richard had made his money from his Jamaican sugar plantations and the nearby Welsh slate quarries. Around 1827 Dawkins Pennant employed the architect Thomas Hopper to transform Penrhyn into a Norman-style Castle, one of the largest castles in Britain. A description of the original heating reads, "In winter hot air gushed from wall and floor gratings in the hall and elsewhere on the ground floor and rose up into the bedroom corridors, while coal burned brightly in all the innumerable fireplaces. The library has hot air gratings and no less than four fireplaces, one in each of its divisions." The Heritage Group survey uncovered traces of this system with an added hot water battery in place of the now removed warm air stove. In addition, the heating was later supplemented by a low-pressure hot water system, which includes Haden radiators, probably of late Victorian manufacture. Evidence was also found of an early gas installation for lighting and cooking in the basement and servants' quarters. Electricity from the public supply appears to have been introduced about 1928. Various items of Victorian sanitary ware were also found. The Castle was given to the National Trust in 1951.

**Domestic boiler**

**Grilles in steps**

**Servants' call board**

**Heater enclosure**


**"Stangate"** G Jennings

**Warm air floor grille**


**Nameplate** Haden

**WC** George Jennings

**Concealed floor heaters**

**Patent WC** Underhay


**"Laurel" WC** Gratix

**Flush** Underhay


**"Hydrofont" sink** Gratix

# THE ORANGERY at KNOLE, KENT

**Knole, nr Sevenoaks**

**Lord Botecourt's Buzaglo stove of 1770**

The decoration has a number of differences to the Knole stove and includes a figure of Justice with scales and sword.

Information from "Fire on the Hearth," Josephine B Peirce, Pond-Ekberg, Springfield, Mass, 1951

***Research Nigel Seeley***
***Colour photos National Trust***

**Ornate heating stove marked "Buzaglo 1774" discovered in the Orangery, Knole, Kent**

A letter dated 7 July 1773, headed "Stoves for Public Buildings" and written in London by Dr Benjamin Franklin refers to the use of Buzaglo's stoves and infers they were in use at the Bank (of England?) and in Lincoln's Inn Hall. It is known that a Buzaglo stove was ordered by Lord Botecourt, then Governor of Virginia, as a present to the House of Burgesses in Williamsburg. This particular stove was described by Buzaglo in his letter of 15 August 1770 to My Lord, "it excels in grandeur any thing ever seen of the kind, and is a Master piece not to be equalled in all Europe." The accompanying instructions are for "putting up the New Invented Warming Machine," which was despatched in seven cases.

*Here with capacious bulk, profound*
*As Falstaff's paunch, as Plymouth's round,*
*A vast Buzaglo, day by day,*
*Shall chase the noxious blasts away*

"The Project," Richard Ticknell (1751-93)

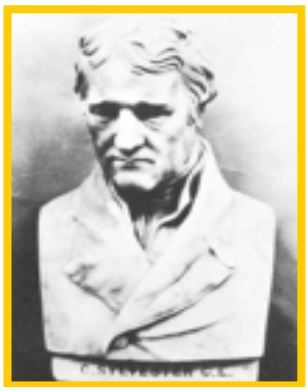
## OSBORNE HOUSE, ISLE Of WIGHT


**Stove: J Sylvester-Engineer-London Patent**

Queen Victoria and Prince Albert bought old Osborne House in 1845, but her Ministers found it totally unsuited to Privy Council meetings. Thomas Cubitt, the London building contractor, was approached to remedy this situation by adding a new wing, then demolishing the existing house and adding further wings. Cubitt, working closely with Prince Albert, provided the drawings and supervised the work, due to the dismay of the architectural profession, which considered this to be a "dishonest" method of building. Before this, around 1820, the Sheffield "chymist" Charles Sylvester set up in London as a heating engineer, having previously worked for Wm Strutt of Derby on the development of the cockle heating stove and various ventilating systems. When he died his son John developed the business. Upon his death in 1852 the firm was taken over by Samuel Egan Rosser, becoming S E Rosser around 1856. In 1866 he took a young marine engineer, Joseph Russell, into partnership, the business becoming Rosser & Russell. At Osborne House in 1893 a lift was added for the benefit of the ageing Queen Victoria: hand-operated by an attendant it was made by Holland & Sons.

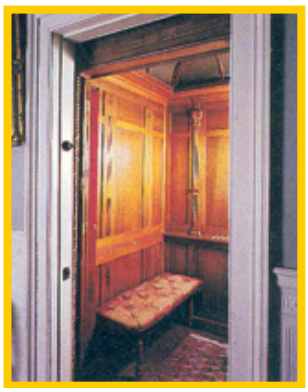
**Whippingham Church, IoW**
Built 1862, sponsored by Victoria & Albert, the architect was A J Humbert, with heating by Price & Co. (Price Bros of Bristol were UK pioneers of hot water heating). The system has been removed.

***Survey & Stove photo Frank Ferris***
***Colour photos English Heritage***



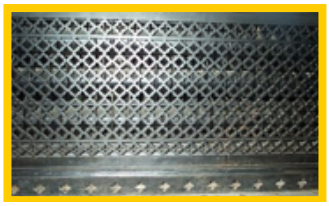
**Charles Sylvester**
1774-1828

**Albert's bath**



**Victoria's lift**

## LACOCK ABBEY, WILTSHIRE



**Heating coils**

Lacock Abbey dates from the 13th century where a religious order flourished until the Dissolution of the Monasteries in the reign of Henry VIII. The Abbey was suppressed in 1539 and sold for £539 to William Sharington, a wealthy landowner from Norfolk. Fortunately, unlike most other monasteries, it was neither dismantled nor destroyed. Sharington converted the upper floor into his home, leaving the ground floor nuns' rooms and cloisters untouched to survive to this day. He has been described as a crook with exquisite taste, for while vice-treasurer of the Bristol Mint he made a great deal of money by "clipping the coinage." Important alterations were made to Lacock in the 19th century by William Henry Fox Talbot, who ranks with Niépce and Daguerre as one of the inventors of photography. The oldest paper print in existence is that made by Fox Talbot in 1835 from a negative of an oriel window in the south gallery. It is generally accepted that the heating system dates from the late 1870s when its installation followed a bequest in the will of the French governess Amelina Petit. The cast-iron socket and spigot pipework, box end pipe coil heaters and pedestals from the original system still exist. The National Trust, which acquired the property in 1944, arranged for the heating system to be completely restored.

**Unknown pipe fitting**
possibly an early type of butterfly valve

***Survey & photos***
***Frank Ferris***


**Victorian kitchen range**
by Sidney Flavel & Company of Leamington


**Wash-out Closet**
Lambeth Patent Pedestal by Doulton & Co in *Blue Magnolia* pattern


**Ventilated "refrigerator"**
by George Kent, High Holborn, Victorian manufacturer of ice cream machines, ice makers, ice moulds and pure block ice

## MONTACUTE HOUSE, SOMERSET

**Hot water radiator**

**Heating coil**

**Four pipe high sinuous coil heater**
with socket and spigot joints, bearing the inscription
*W Sparrow -Martock*

Montacute is a great Elizabethan House, begun in 1588 for Sir Edward Phelips, finished in 1601, and now a National Trust property. Sir Edward was an MP, Speaker of the House of Commons and led the prosecution at the trial of Guy Fawkes. The house is notable for the Long Gallery of 189 ft, running the whole length of the house. The family leased the house to Lord Curzon from 1915 until his death in 1925. The heating system features a variety of cast-iron pipe coils, some with box end headers, as well as a number of *Ideal* window radiators as manufactured by the National Radiator Co Ltd.

***Survey & photos Frank Ferris***

**Heating Coil** W Sparrow -Martock

**3-pipe box end coil**

**Kitchen oven**

**Kitchen range**


**Nameplate**
Hill Sawtell & Co Ltd, Yeovil

**Nameplate**
The Gold Medal *Eagle* Range

# KINGSTON LACY, DORSET

**Decorative heating pedestal**
Lady Bankes by Baron Marochetti with finned coil in base

Sir John Bankes, Chief Justice to Charles I, purchased the old royal estate of Kingston Lacy c.1636. Later, Sir Ralph Bankes, knighted by Charles II, employed Sir Roger Pratt as his architect for the building of Kingston Hall (1663-65). Henry Bankes remodelled the house in the 1780s. From 1835-41, his son William (a friend of Byron), with some help from Charles Barry, transformed the Hall into the house we know today. In 1841 William was prosecuted for "a breach of sexual convention" and went to live abroad, from where he designed and commissioned fittings in marble and wood for the house interior. The National Trust was bequeathed the Kingston Lacy estates in 1981. The present house has a varied and unusual selection of heating pedestals and a collection of antique telephones.

**Domestic water service boiler**
with side "mudholes" for clean-out

**Heating coil**
having tubes with annular disc fins

***Survey & photos***
***Frank Ferris***

**Cast bronze heating pedestal cover**
depicting Corfe Castle once owned by the Bankes family

**Part of the antique telephone collection**

**Decorative heating pedestal**
of Italian Carrera marble
with an inset bronze medallion

## SPEKE HALL, LIVERPOOL

The house was built in the 16th century by the Norris family, declaring it was completed in 1598. The Watt family bought it in 1795, restored it, and later in 1867-77, rented it to Frederick Leyland, Liverpool shipping tycoon and patron of Morris, Rosetti and Whistler. In 1941, it passed to the National Trust.

The central heating system was installed in two phases. The original 1895 installation used cast iron socket and spigot pipework serving a variety of pipe coil heaters, mainly in corridors and hallways. These heating coils are of a size and style not previously found elsewhere by the Heritage Group. For example, that in the Great Hall is 10 pipes high and 4 rows deep. The heating system was upgraded around 1910 and serves perimeter rooms using steel pipe and wrought iron fittings feeding cast iron sectional radiators. Both phases appear to have been installed by Charles Seward of Preston, founded as a branch of A Seward of Lancaster. The parent firm can be traced back to Abraham Seward who in 1778 was appointed Tinplate Worker in the Ordinary to King George III, and is known to have been installing oil heating and lighting in 1808.

**Heating coils**


**Air vent plug**
"Sewards, Lancaster"

**4-row 10-pipes high heating coil in Main Hall**
with nameplate "C Seward, Preston"

**Globe valve**
oblique pattern with
side indicator scale

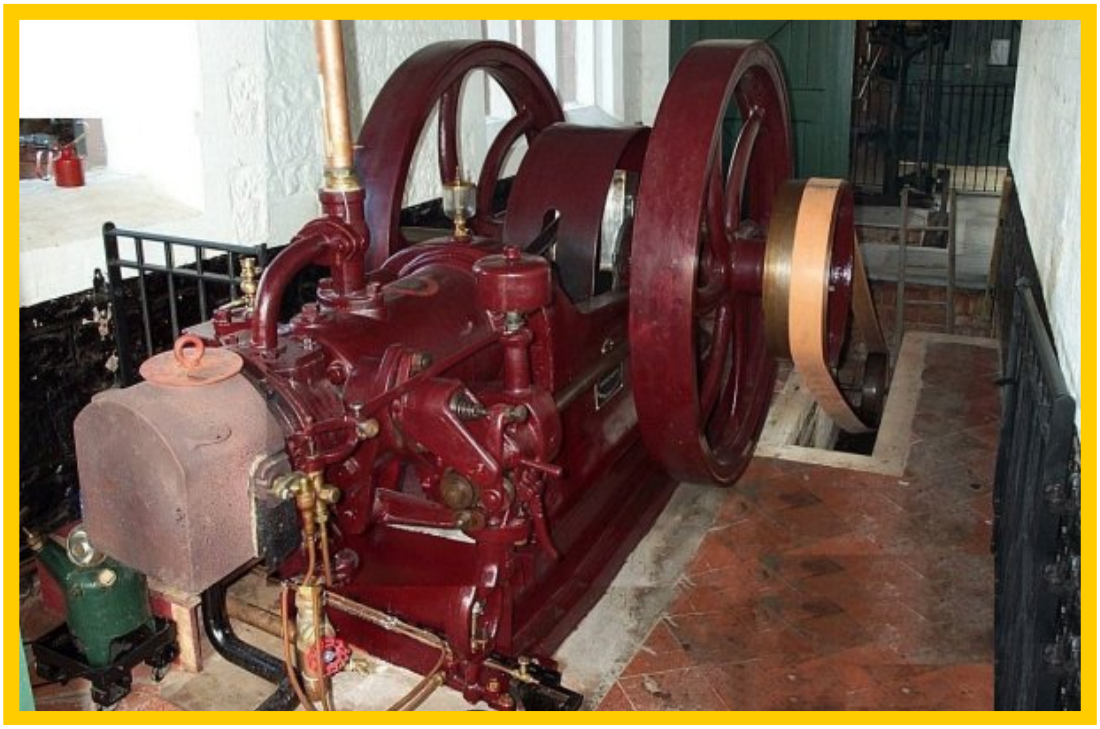

***Survey & photos Frank Ferris***

**Kitchen range** London Warming & Ventilating Co

**Domestic boiler** Ideal 14D


**No.7 "KOOKSJOIE" range** door

**Electrical switchboard** 1930s remains



**Oil engine in Engine House** [Hornsby No.48343, 9 in diam cylinder x 18 in stroke]

**Banks of heating coils**

**5-tier 5-row cast-iron heating coil**
Bottom main staircase

**12-section cast-iron vertical pattern radiator**
Billiard Room

**8-section vertical radiator**
Water Colour Gallery

***Survey & photos Frank Ferris, Linda Bullock & Paul Yunnie***

## CRAGSIDE, NORTHUMBERLAND

Cragside was built over the period 1869-84 to the designs of the architect Norman Shaw. The client was Sir William Armstrong (1810-1900), the greatest of Victorian armaments manufacturers and the "Father of Hydraulic Engineering." Many of the rooms in the original part of the house are heated by a warm air ventilation system of structural ducts with banks of heating pipes (pictured upper left) located in the basement. Later parts of the house are heated by a low-pressure hot water system with a variety of pipe coil heaters and radiators. It is possible that the heating coils, which bear no distinguishing marks, were made in one of Armstrong's factories. Armstrong was a friend of the electric lighting pioneer, Joseph Swan, and Swan lamps were fitted throughout the house and in use by December 1880. Previously there had been an arc light in the picture gallery. Power was provided by hydroelectricity with a water turbine and dynamo. Hydraulic systems operated a lift, a kitchen spit and moved heavy pots in the conservatory. There was an internal telephone system with a connection to the powerhouse, an electric sewing machine and a system of electric gongs. A fantastic cast-iron footbridge (above) spans the gorge. A contemporary paper described the house as "truly the palace of a modern magician." It was taken over by the National Trust in 1977.

**Thomas Parker dynamo**
Installed by Drake & Gorham

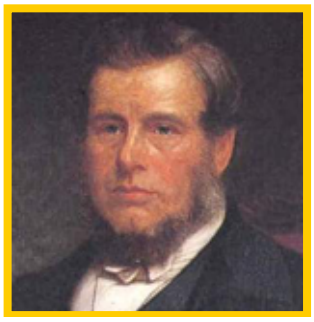
**4-tier treble row pipe coil heater** First floor landing

**Kitchen range**

**6 hp water turbine with Siemens dynamo, 1878**

Series wound, bipolar horizontal pattern with drum armature & single magnetic circuit

## MANCHESTER TOWN HALL



**George Nelson Haden**
1817-92

**Alfred Waterhouse**
1830-1905

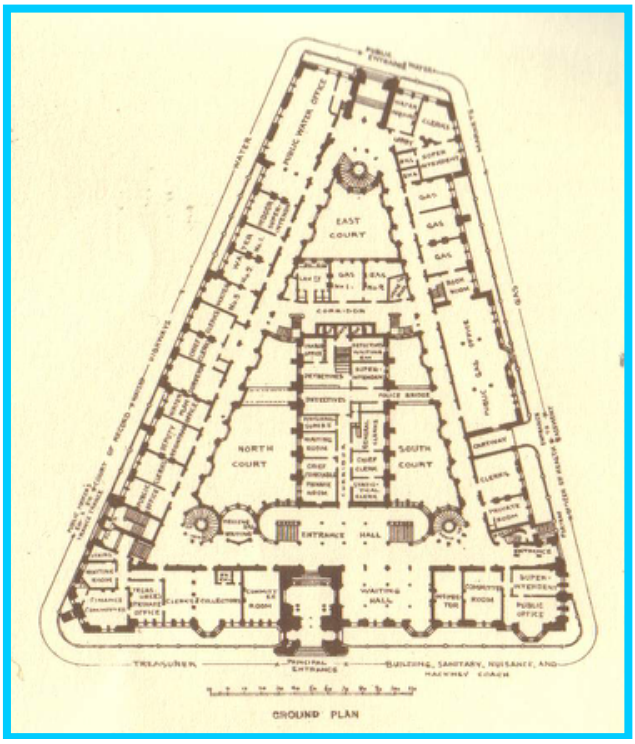
**Ceiling decoration**

**Bee floor mosiac**
Symbolic of Manchester's industry

***Research & photos of services by Geoff Brundrett***

The entries for the architectural competition of 1867 arranged by Manchester Corporation for a new Town Hall were assessed on the basis of form of site, general arrangements, sufficiency of light, provision of ventilation and warming, acoustic properties of large hall and Council Chamber, and cost. Speakman and Charles were placed first under the head of excellency of elevation, but Alfred Waterhouse was adjudged to have more successfully met the overall requirements and, amid considerable controversy, was appointed as architect. The triangular site posed a number of problems, but Waterhouse designed a building with an area of 8648 square yards having three principal fronts, each between 300 and 400 ft in length. The foundation stone was laid in 1868 and the building occupied in 1875. The work of G N Haden & Sons was described as follows: "For the warming of the building, three hot-water boilers (one always being kept as reserve) are placed in a large sub-basement. The smoke from the furnaces passes through two wrought iron tubes places within ventilating shafts, with an intervening air-space for the extraction of vitiated air. From the boilers, hot-water pipes traverse the main rooms and corridors in channels below the floors, -everywhere on the window side, coils being placed in all convenient and desirable positions. The prisoners' cells are also warmed by the hot-water service. I may here mention that, on the inner side of the corridors, there are corresponding channels, covered, like those for the hot-water pipes, with gratings, in which are placed the pipes of the gas and other services. Into the central ventilation shafts just referred to, the vitiated air of the public hall is conducted through the space above the ceiling, from which there are connecting channels. The same shafts ventilate the corridors also, while separate extraction flues are carried up the chimney shafts from all the principal rooms. Fresh air is admitted behind the hot-water pipes and coils, brought in through perforations under the window sills; other ducts for fresh air discharge under the coils at the bottom of the wells of the circular staircase, for the supply of warmed fresh air to the corridors; while over the doors of the rooms flapped or louvred ventilators, opening and closing at pleasure, admit fresh air to the rooms from the corridors."

Reference: *Description of the New Town Hall at Manchester*, paper read to the RIBA by A Waterhouse, 19 February 1877




**Plan of Ground Floor, Town Hall**

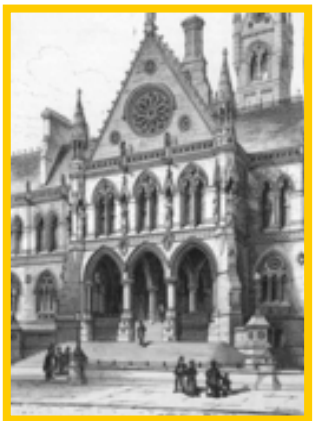
**Lighting in The Great Hall**

**Hot water heating coils in ventilation shaft**

**1868 elevation**

The building had a telegraphic system between the major offices. There were 350 rooms, 700 external windows and 80 water closets. Large cellars were provided for the storage of coal, these being accessible by the cart entrance, and communicating with the upper floors by hydraulic lifts. The lighting was by gas.

**Heater enclosure**

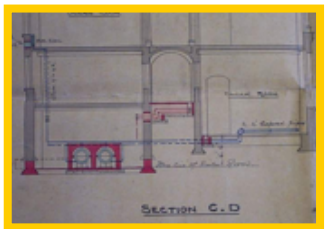


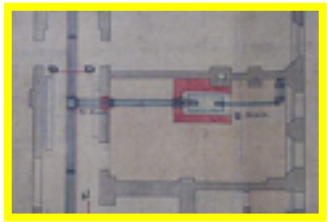
**Assize Courts**

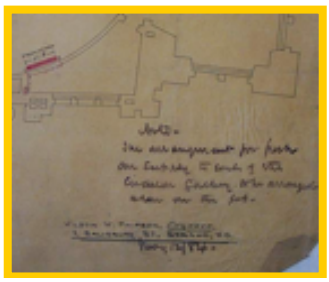
Another Manchester project, built 1865, where Haden worked for Waterhouse, installing an early air washer in the ventilation system.

## BIRMINGHAM COUNCIL HOUSE

**Birmingham 1900**
Council House (centre)
Town Hall (right)



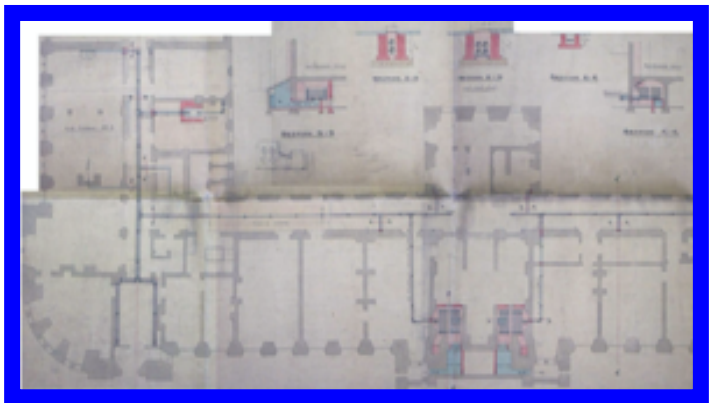



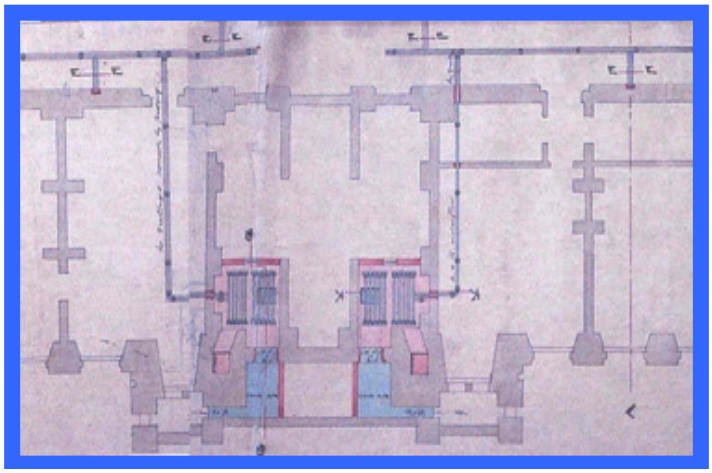


**Drawing details**

**Grave of Phipson and his father in Putney**
photo Richard Forster

***Reasearch, Frank Ferris***
***Drgs from Birmingham Library & Record Centre (1460/45 & 46)***





**Plans of heating & ventilation, c.1874**

Originally known as Birmingham New Municipal Buildings, the scheme was sponsored by Joseph Chamberlain and built by John Barnsley & Sons from 1874-79 (extended in 1886) in a "decidedly classical" style to the designs of Yeoville Thomason. Wilson Weatherley Phipson (1838-91) designed the heating & ventilation. His drawings show the ventilation was of the heat-assisted type. Cold fresh air was taken in at basement level, and then passed over banks of cast-iron heating pipe-coils. The warmed ventilation air then rose through the building, the vitiated exhaust air being taken through ceiling ducts into the roof space and to atmosphere. Boilers circulated hot water by gravity to the coil-banks and to radiator-shaped pipe coils scattered around the building in the smaller rooms. Phipson also designed systems for Birmingham's Victoria Law Courts ((1886-91) and remedied the bad ventilation at the Town Hall (1891, his last work).

**Birmingham Council House**

## VICTORIA & ALBERT MUSEUM, LONDON

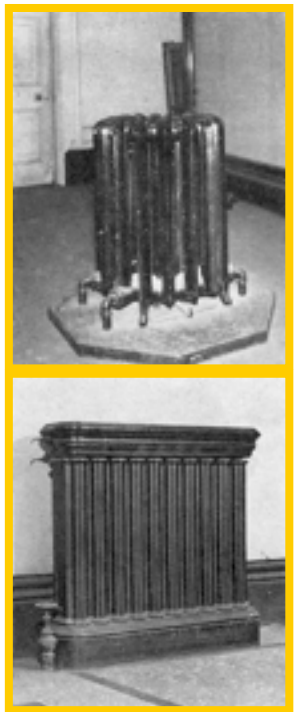
**Electrified gasolier**

**Existing ventilation plant with spray washer**

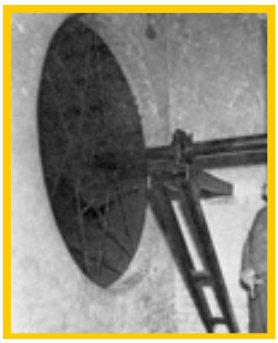
In 1891, shortly before his death, the Victorian engineer Wilson Weatherley Phipson wrote to the architect Aston Webb in connection with the proposed heating, ventilation and lighting of a new building to extend the South Kensington Museum. His scheme included steam boilers, a 6 ft square underground tunnel running the length of the building containing all service pipes, and equipped with air propellers to draw fresh air into the tunnels from a central tower. The fresh air was to be distributed through vertical shafts fitted with local heaters. It is believed Phipson intended to install steam-driven electricity generators and to utilise the exhaust steam. Webb won the architectural competition, though the actual work was postponed for many years, and what became the Victoria & Albert museum was built to a greatly modified design (1899-1909). In June 2003, the Heritage Group braved the maze of basement service tunnels and came to the conclusion that the original scheme probably embraced many of Phipson's proposals

***Survey & colour photos Mike Barber***

**The V&A** 1909



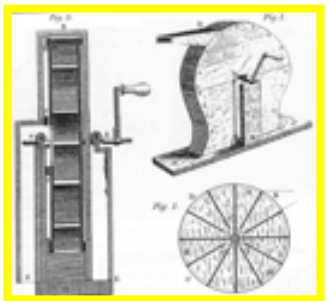
**Radiators** c.1900



**Paddle blade fan**
14 ft diameter, c.1900

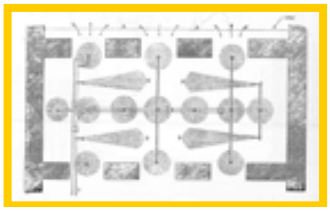
## THE PALACE OF WESTMINSTER

**Destroyed by fire**
16 October 1834

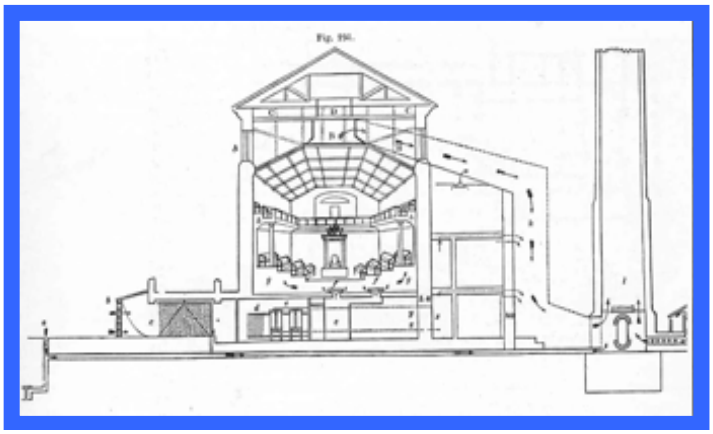


**Fanning wheel**
Introduced by Desaguliers into the Commons in 1735. The man who turned the crank was termed *ventilator*

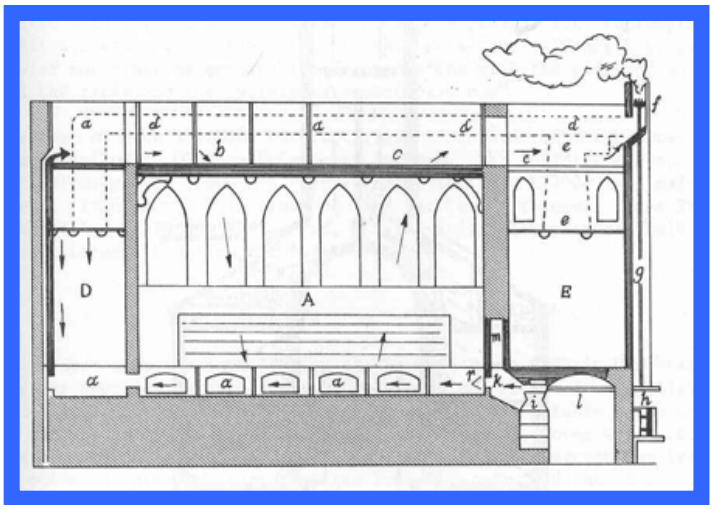
**David Boswell Reid**
Charlatan or genius?



**Reid's air washer**
Serving the Temporary House of Commons, 1838 and located in Guy Fawkes' vault. Reid suggested the adding of orange, cinnamon lavender & camphor to the air.



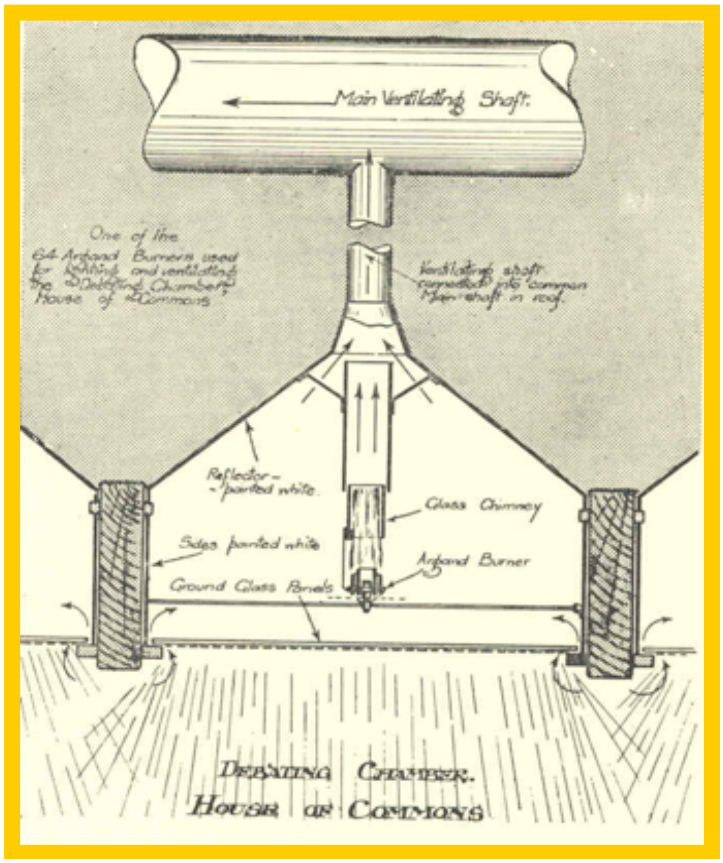
**Reid's scheme for the House of Commons**
From his *Illustrations of Ventilation,* 1844




**Barry's scheme for the House of Lords** 1847

After the fire of 1834, Charles Barry was appointed as architect and Reid as ventilating engineer, independent of the architect. For the Commons, Reid proposed to introduce filtered and humidified air through holes in the floor and to extract the vitiated air through the ceiling, conducting the air to the base of a chimney (so-called fire assisted ventilation). The scheme included provision for summer cooling "by nocturnal ventilation, by evaporation of water, by passing cold water through a heater battery and, in rare cases, by the use of ice." His acoustic design proposals were well ahead of his time. However, Barry and Reid were in continual conflict. It seems Barry wouldn't provide drawings to Reid, who rarely bothered to use drawings at all. They each obstructed the work of the other. To break the stalemate, Barry was given charge of the ventilation of the Lords for which he employed Alfred Meeson, a skilled engineer. In 1852, Barry finally had Reid dismissed. The ventilation was altered by Sir Goldsworthy Gurney, who ran around the Commons Chamber flashing off great quantities of gunpowder to observe the movement of smoke. These actions were said to have posed a greater danger than Guy Fawkes. For nearly another 90 years, numerous committees and engineers wrestled unsuccessfully with the problem. It was taken out of their hands when the Chamber was destroyed by enemy action in May 1941.

***Research by Neil Sturrock***

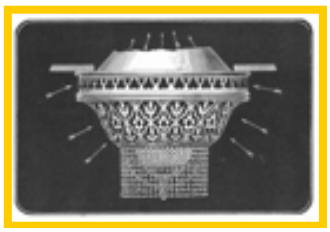



**Ventilated gas burner, House of Commons** 1852

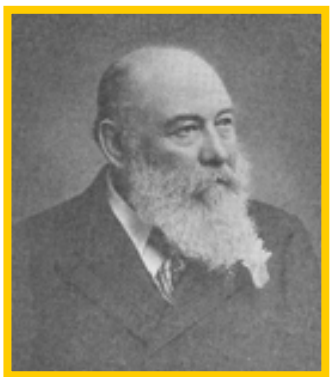
In the new Palace of Westminster, gas lighting was installed in both Chambers, with large gasoliers in important areas including the Central Hall and the Royal Gallery. These used simple round flame burners except in the Royal Gallery, where the fishtail type was employed. The impure combustion products added to the ventilation difficulties, so Faraday burners were installed in the Lords. The system proposed by Reid for the Commons in 1852 was not greatly liked, but a modified scheme using 64 Argand burners continued in use until the turn of the century. In 1883 Col R E Crompton installed the first electrical installation, powered by two dynamos driven by steam engines. Each plant was capable of supplying 380 lamps of 8-candle power. In 1890 a supply was obtained from the City of Westminster Syndicate, enabling a further 1768 lamps to be lit. In 1894 self-generation was discontinued and a supply equal to 3000 lamps was agreed. With the rebuilding after the war came the need for substantial ac supplies for the air conditioning, but in addition mercury arc rectifiers were installed to provide dc for the speed control of ventilation fan motors. Two separate 6.6 kV ring mains were installed. Over time the original magnificent brass lamp fittings, designed by A W N Pugin, have been converted from candle, oil or gas to electric lighting.

The Heritage Group toured the Palace over 50 years ago and the then Resident Engineer, John F B Darwin, produced two papers on the engineering services: *Yesterday in Parliament*, Building Services (JCIBS), March 1980, and *Plumbing,. water systems and drainage in the Palace of Westminster*, Plumbing, October 1981. The Group returned in February 2004, visiting the House of Lords Records Office to view various documents.

***Additional research by Christopher Sugg***
***a descendant of William Sugg***

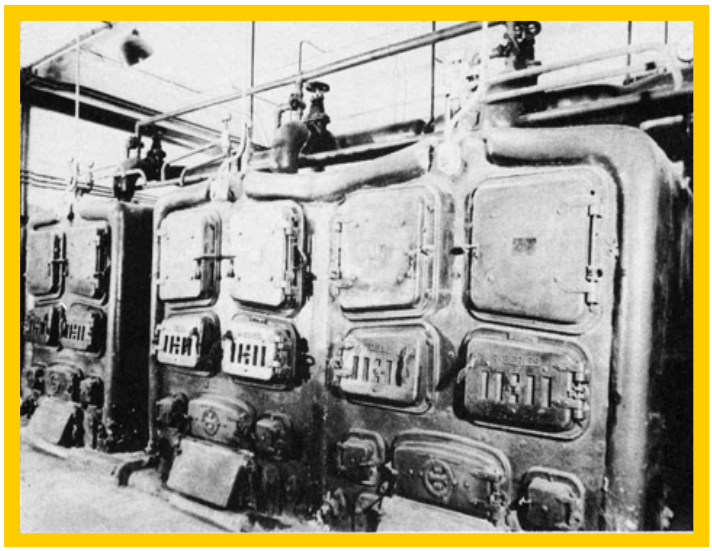


**Ventilating Sun Burner**
Sugg 1883



**William Sugg**
Gas lighting pioneer who wrote *Ventilation and Warming* in 1895, describing the systems at Westminster

**Sugg Exhibition**
Crystal Palace 1887

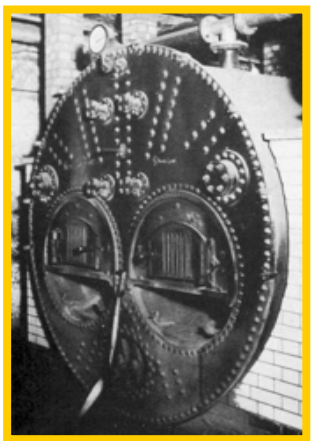


**Ideal Series R steam boilers serving heating system**
now removed

**House of Commons Pump Room** c.1950

The rebuilt Commons Chamber was air conditioned to the designs of Oscar Faber & Partners, the contractor being Benham & Sons Ltd. The Lords was not air conditioned until 1967. It was back in 1894 that Sir Isaac Holden had recommended that the steam pipes and radiators around the building be changed to hot water, but it was not until 1977 that a rolling programme of installing special room fan-coil air conditioning units was begun.

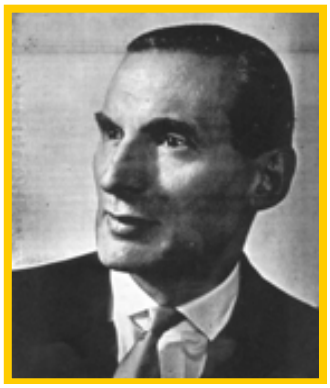
For detailed information refer to *The heating and air conditioning of the House of Commons,* Oscar Faber & J R Kell, JIHVE, 19, 1951



**Lancashire boiler**
now removed

**Dr Oscar Faber**
President IHVE 1944-45

**J R Kell**
President IHVE 1952



**C S K Benham**
President IHVE 1958

## ROYAL LIVER, LIVERPOOL

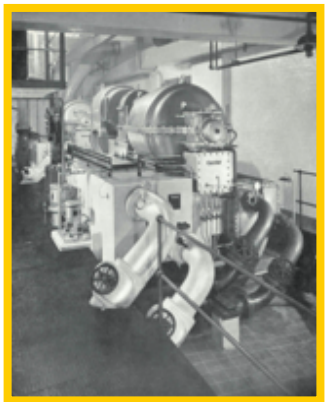
**J LMusgrave**
Joint Governing Director
Richard Crittall & Co
President IHVE 1927-28

Completed in 1911, the architect for the Royal Liver Building was W Aubrey Thomas. Its dimensions were 301 ft long by 177 ft 6 in wide, the height from pavement to main roof being 170 ft and to the top of the towers some 300 ft. The skeleton was of reinforced concrete, the walls of grey granite. The huge clock face is 25 ft diameter, while the famous bronze liver birds at the top of the two main towers are 17 ft high. It was provided with 15 high speed electric passenger lifts by Waygood & Co, with a further 3 goods lifts –two electric and one hydraulic. A contemporary account of the installation by Richard Crittall & Co (later part of Crown House) reads: "*Heating and Ventilating Wonders.* The heating and ventilating arrangements deserve a special mention, as being the most perfect that science has yet devised. The heating is accomplished by means of hot water supplied from a great boiler house in the basement (4 coal-fired boilers with Bennis stokers), circulating through a network of small pipes fixed under the Durato (asbestos composition) flooring and in wall panels, and radiating warmth at the discretion of the occupants. As the fresh air enters a room, whether through the door or through the adjustable inlet gratings under every window, it acquires the desired temperature from the radiation (strictly speaking convection) of the hot water pipes, the strength of which may be regulated with nicety. Closely connected with the building are of course the ventilating arrangements, which are such as to ensure a free and safe circulation of pure air through the vast structure. Every corridor has a double ceiling, and into the cavity thus formed the foul air is admitted through gratings in the upper part of the office walls, and thence drawn up and ejected by powerful revolving fans through three great upright rectangular vent shafts, measuring ten by ten feet."

Above description taken from the celebratory booklet of the opening.
More details are available in *Current Architecture: The Royal Liver Building, Liverpool*, The Architectural Review, October 1911.

***Research by Neil Sturrock & Mike Barber***

## CUMBERLAND HOTEL, MARBLE ARCH



**Carrier centrifugal water chilling refrigeration machine**
electric motor driven


**Carrier Logo**
From the catalogue *Indoor Air by Carrier*, 1930s

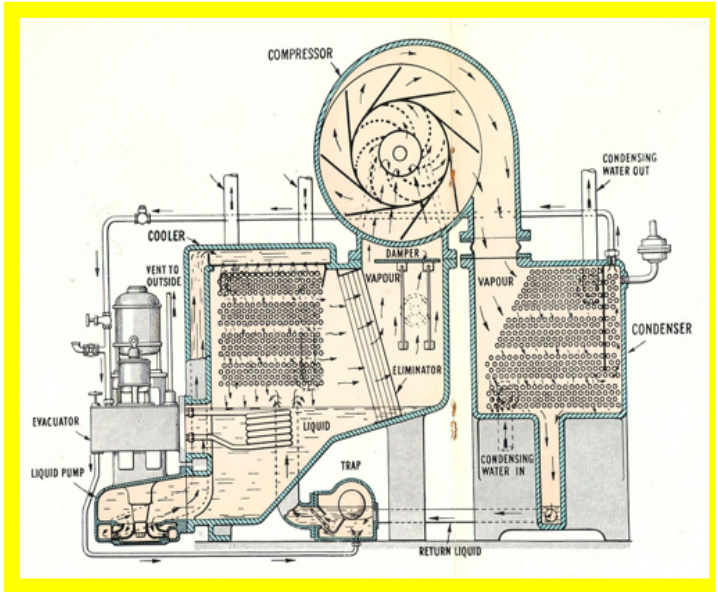

Our Acceptance of Responsibility

Guarantee

The Carrier System of Air Conditioning is guaranteed to Automatically maintain constant conditions of temperature and humidity in any given closed space, full or empty, night or day, winter and summer, without draughts.

Carrier Engineering Company Ltd London, SW

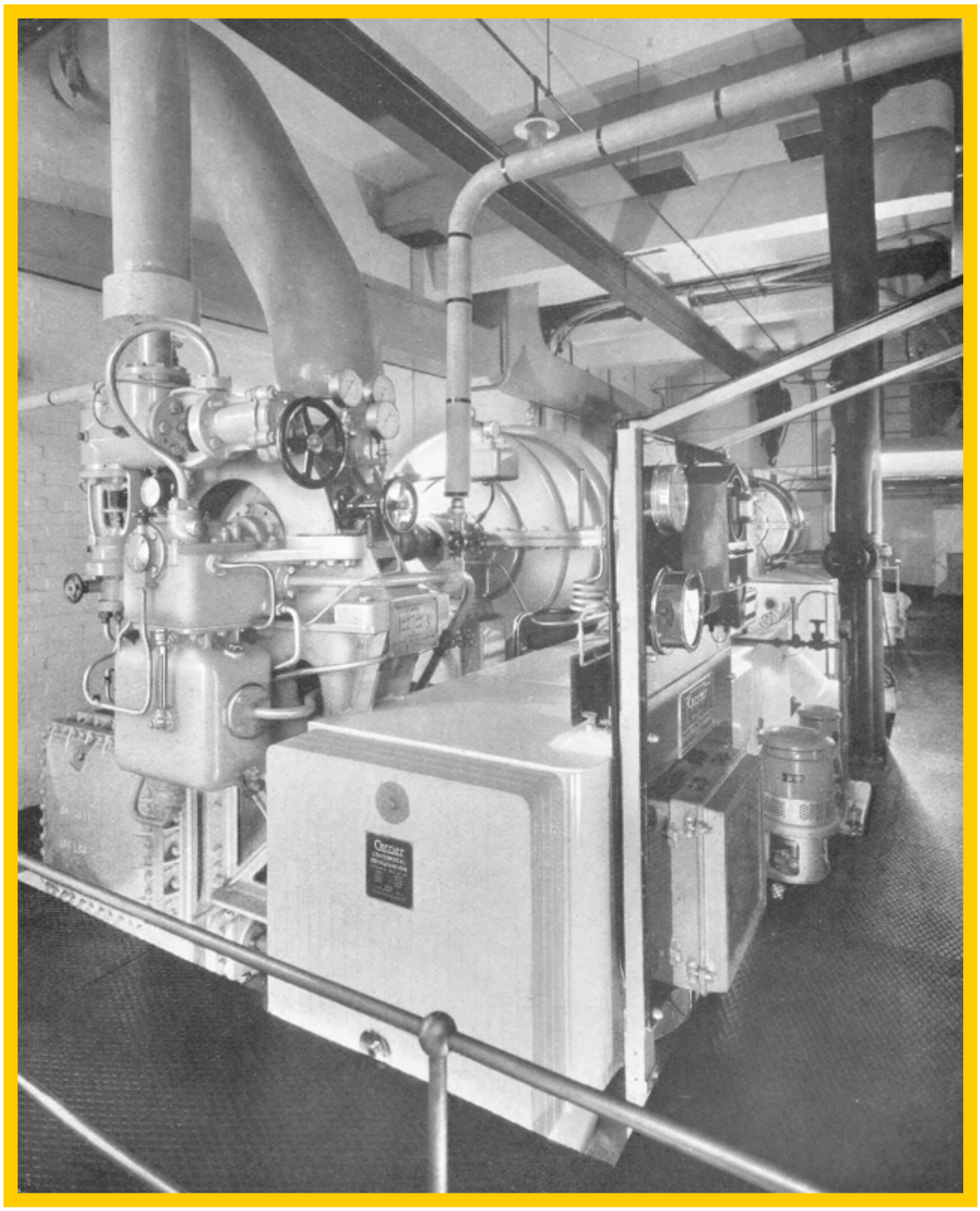
**Carrier Guarantee**




**Carrier centrifugal water chiller** 1930s

The Cumberland Hotel at Marble Arch was opened in 1933. Owned by J Lyons it was built by their Works Department. The architect was F J Wills with the public rooms designed by Oliver Bernard. The design-contractor for the air conditioning was Carrier Engineering Company of London (CEC). The hotel took its name from the *Duke of Cumberland* a public house, which stood on the site from 1747 until the start of the 20th century. The Cumberland was soundproofed, double glazed, with air conditioning for the public rooms and all 900 bedrooms, each of which had en-suite facilities. The structure consisted of 13 floors, 10 above ground with 3 below, and used 15,000 tons of steel, including a massive 100 ton girder "which required the world's largest lorry to convey it." The hotel employed 2000 staff, housing 300 girls in a special annexe. CEC also provided air conditioning for the Trocadero Restaurant, and for public rooms at the Dorchester hotel, the Strand Palace hotel and the Regent Palace hotel (the two last-named were also owned by J Lyons). The Heritage Group has discovered that a steam engine driving a ventilation fan was removed from the Cumberland around 1980.

***"Manufacturing the Weather" an unpublished history of Carrier Engineering Co Ltd, Brian Roberts***



**One of two Carrier centrifugal water chillers installed at the Cumberland**
This unit was driven by a steam turbine, while the other machine (opposite page) had an electric motor drive. The combined refrigerating capacity was 500 TR.

## CIBSE HERITAGE GROUP

**Meeting of the CIBSE Heritage Group Committee in the Council Chamber at the CIBSE Engineering Centre, Balham, London, on 21st November 2003**

[Left to right]: Frank Ferris [Newsletter Editor & Webmaster] Brian Roberts [Chairman]
David Drewe [English Heritage] Nigel Seeley [University College London] Mike Barber [Hon. Secretary]
Ian Stewart [Hon. Treasurer] John Barnes, Christopher Sugg [Institute Gas Engineers & Managers]
Linda Bullock [National Trust] Paul Yunnie [Vice-Chairman] Richard Forster
Other members, not pictured: Tim Bowden, Geoff Brundrett [President CIBSE 1997] Jane Insley [Science Museum]
Stephen Loyd [BSRIA] Geraldine O'Farrell [English Heritage] Colin Pearson [BSRIA] Laurie Wilkins

## CREDITS

This second book on Building Services Heritage is again a collaborative effort by the members of the CIBSE Heritage Group including those pictured and listed above back in 2003. Thanks are also extended to members who have contributed to the store of books, documents, photographs and illustrations in the Heritage Group Collection. A special thanks goes to our friends at English Heritage, Historic England and National Trust for their considerable assistance, and to the people and organisations listed at the bottom of each page.

Originally drafted in 2004 this version has been updated in 2020 by Brian Roberts & Frank Ferris

## REMEMBERING

The Heritage Group pays tribute to and remembers the people from the Group sadly, who have passed on and no longer with us.

**NEVILLE BILLINGTON OBE**
**JEFFREY COOK**
**LOUIS RIKKER**
**IAN STEWART**
**GARY BENNETT**
**ALEC PELHAM**
**NIGEL SEELEY**
**LAURIE WILKINS**

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