THOMAS SUTCLIFFE MORT
1816-1878

Pioneer of the Frozen Meat Trade

By 1867 it was clear in Australia that frozen meat was the only answer in long haulage transportation and since this was an island continent, the frozen condition must be maintained on shipboard for about three months as a minimum to get the cargoes to Europe. The Sydney Chamber of Commerce turned to Thomas Sutcliffe Mort, because

his newly found interest in Eugene Nicolle's inventions in refrigeration,[12] allied with his enterprise and foresight made him a possible entrepreneur. They were not to know it then, but it would be ten years before Mort and Nicolle would make their attempt to place plant on a ship to take a frozen meat cargo to England and have it fail in Sydney Harbour.

(From "James Harrison-Pioneering Genius," W R (Roy) Lang, 2002)

2.411. The *British Empire* was the first to face the problem. In Victorian (1) Britain the industrial revolution was in full swing and the population was increasing rapidly (2). A series of poor harvests in England in the 1840's had left bitter memories of the "hungry forties". In its turn, Australia in 1850 had an economy founded on gold and wool, but began to consider the possibilities offered by its breeding of cattle. Starting in 1847, it began timidly to export canned meat, but without much success since in 1870 the tonnage was less than 1 000 t; it reached a maximum of 7 000 t in 1880. Then Thomas Sutcliffe Mort (1816-1878) intervened; he was an Englishman who had emigrated to Australia in 1838 to deal in wool. He was associated with the Frenchman Eugène Nicolle (1824-1895) who had emigrated in 1853, and who was an engineer in the firm of Russell, mechanical engineers in Sydney. (This firm, some years later, was to make Harrison's machines). Mort clearly realised the future open to this colony in feeding Great Britain, and with Nicolle resolutely set to work to solve the problems. From the first, they envisaged the export of frozen meat, and in 1861 in Lightfoot Valley (150 km from Sydney) they installed the first factory for freezing of meat. Nicolle, who was a staunch supporter of Carré's absorption machine, installed one in this factory in 1863-64. The Scotsman Harrison*, who arrived in Australia in 1837, completed the trio; he lived in Geelong, near Melbourne, and was also concerned with export of Australian meat.

(From "A History of Refrigeration," Roger Thevenot, International Institute of Refrigeration, Paris, 1979)

In the mid-1860s Mort began to look to refrigeration as a possible solution to three main problems: as a pastoral financier he was vulnerable to falling wool prices on the value of pastoral assets; as owner of a large engineering plant, he was anxious for manufacturing orders; and as a milk and butter producer he wanted better access to the Sydney market. From 1866 until 1878 he financed experiments by E. D. Nicolle to design and produce refrigeration machinery suitable for use in ships, trains and cold-storage depots. Successful land trials prompted a premature public subscription to finance a trial shipment of frozen meat to London in 1868; another subscription was opened in 1875 for a shipment that was loaded in the *Northam* in 1877 but removed before sailing because of a mechanical defect. Although their machinery was never used in the frozen meat trade, Mort and Nicolle developed commercially viable systems for domestic trade which were brought together in the New South Wales Fresh Food & Ice Co. formed in 1875. They included a slaughtering and chilling works at Bowenfels in the Blue Mountains, a cold store at Darling Harbour, milk depots in the Southern Tablelands, and refrigerated railway vans for meat and milk. The refrigeration venture, on which Mort spent over £100,000 and from which his return was negligible, points up more sharply than any other the business judgments and character of the mature Mort. Like the dock and Bodalla, the investment was a community service that could not be justified after the event by normal economic criteria.

(From adbonline.anu.edu.au/biogs)

In the mid 1860s, Mort had been looking at refrigeration as a way of developing manufacturing orders, to ensure better access to the Sydney market for the butter and cheese he was producing at Bodalla and to offset the vulnerability of being exposed to falling wool prices. Mort financed experiments by Eugene Dominic Nicolle, a French born engineer who had arrived in Sydney in 1853 and registered his first ice-making patent in 1861. In 1861 Mort established at Darling Harbour the first freezing works in the world, which afterwards became the New South Wales Fresh Food and Ice Company. The first trial shipment of frozen meat to London was in 1868. Although their machinery was never used in the frozen meat trade, Mort and Nicolle developed commercially viable systems for domestic trade, although the financial return on that investment was not a great success for Mort.

As a part of his refrigeration works, Mort developed a large abattoir at Lithgow where sheep and cattle from western New South Wales were slaughtered and refrigerated for later transport. In 1875, to mark his achievements in the refrigeration techniques, Mort arranged a picnic for 300 guests. He organized a special train from Sydney and fed his guests food that had been refrigerated at his plant for over 18 months.

Darling Harbour 1877

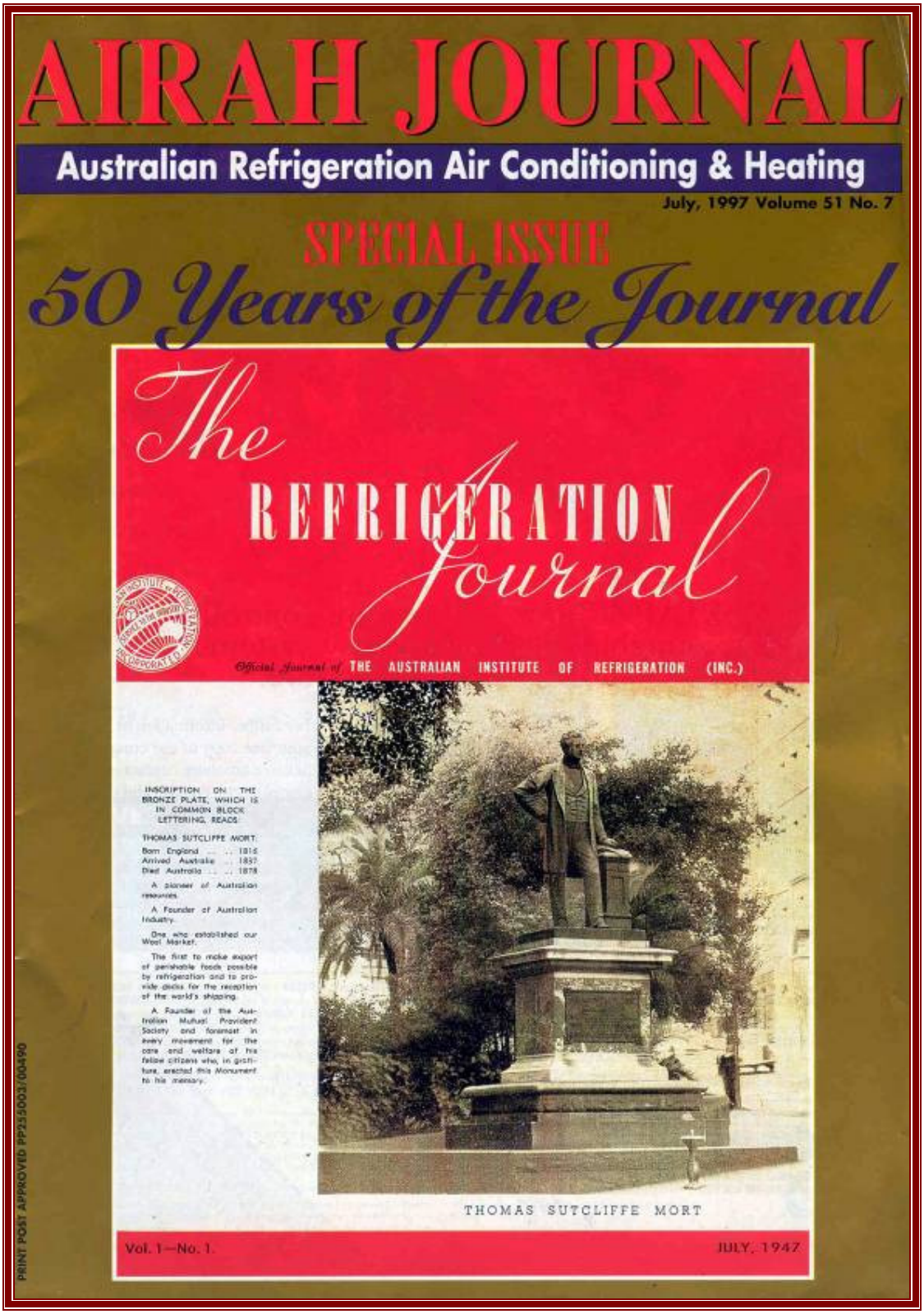
Total involvement

It was successful auctioneering rather than an engineering background which led to Thomas Sutcliffe Mort's involvement in the progress of refrigeration, enabling him to support less profitable social or economic enterprises such as the development of primary industries, in which he played a prominent role mid-last century. Interested in the application of cold to the preservation of meat, he became involved with French engineer Eugene D Nicolle and Augustus Morris, who together conceived a scheme for exporting meat to England. The two men had been ridiculed until Mort saw the possibilities of the venture and prepared to invest in the business. The Chamber of Commerce became interested, and the Government offered a substantial sum to the first person to successfully transport 200 tons of uncooked meat to London.

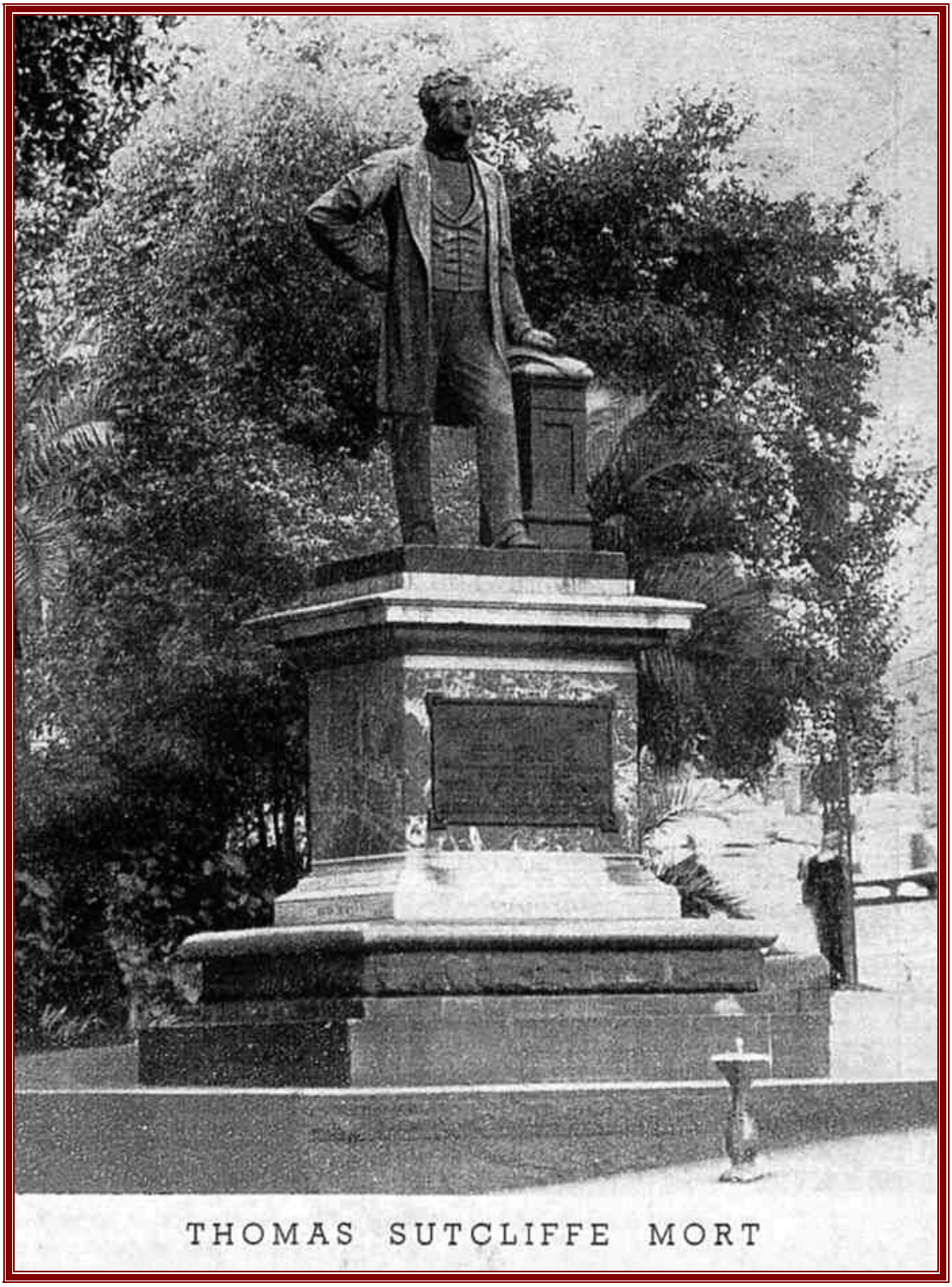
Thomas Sutcliffe Mort

Mort established an experimental cold room plant in the old Royal Hotel in George Street, Sydney, and erected his first big plant at Lithgow, where the cattle were to be killed and shipped back to Sydney in special trucks.

He booked space on the *Northam* which was leaving for England in 1877 but unfortunately the venture failed, partly due to a breakdown of apparatus. In 1880, the *Strathleven* landed the first successful cargo of Australian meat in London.



(CIBSE Heritage Group Collection)



Statue in Sydney

INSCRIPTION ON THE BRONZE PLATE, WHICH IS IN COMMON BLOCK LETTERING, READS:

THOMAS SUTCLIFFE MORT.

Born England 1816
Arrived Australia .. 1837
Died Australia 1878

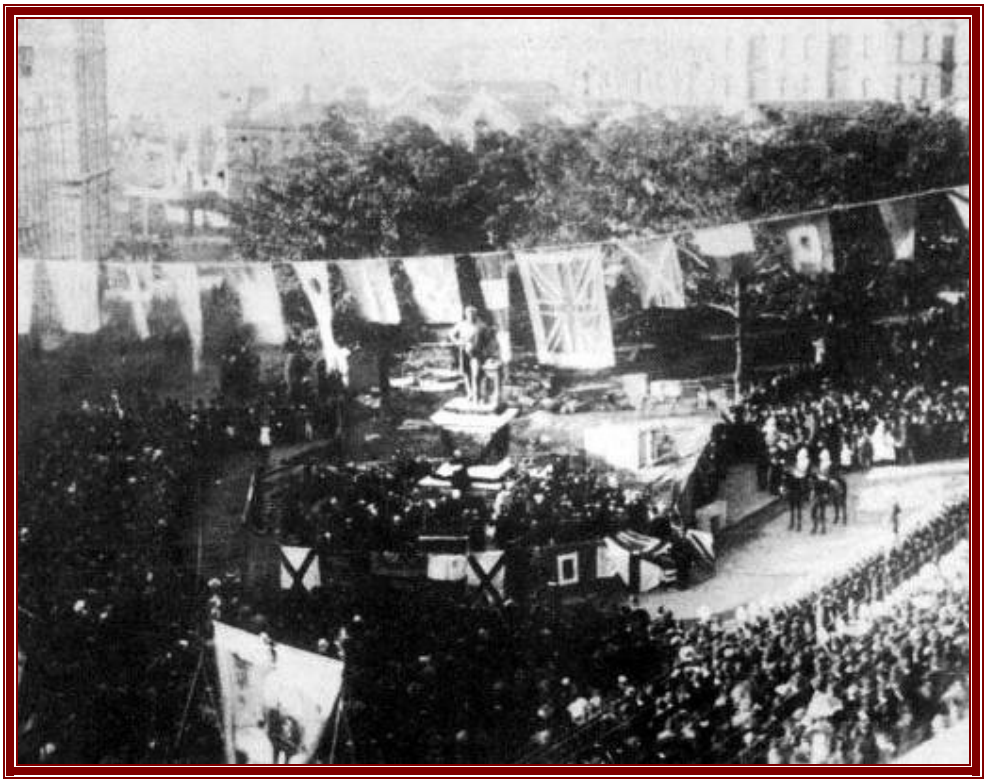
A pioneer of Australian resources.

A Founder of Australian Industry.

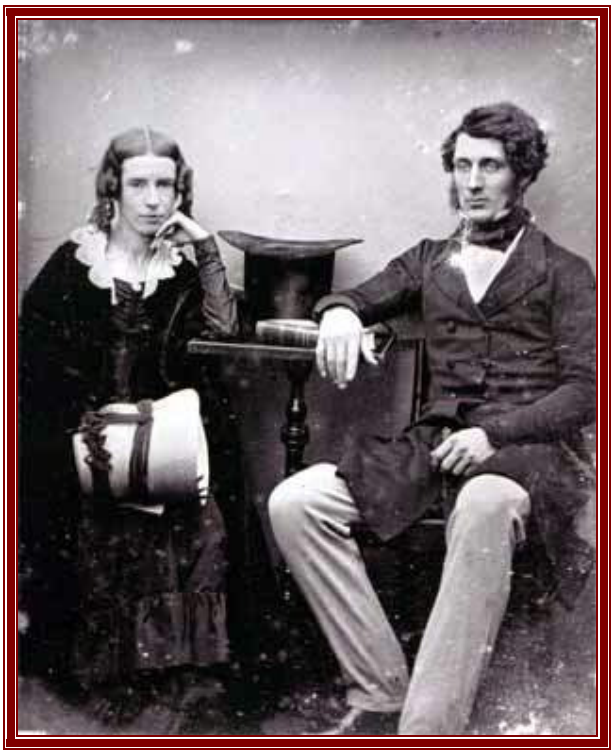
One who established our Wool Market.

The first to make export of perishable foods possible by refrigeration and to provide docks for the reception of the world's shipping.

A Founder of the Australian Mutual Provident Society and foremost in every movement for the care and welfare of his fellow citizens who, in gratiture, erected this Monument to his memory.



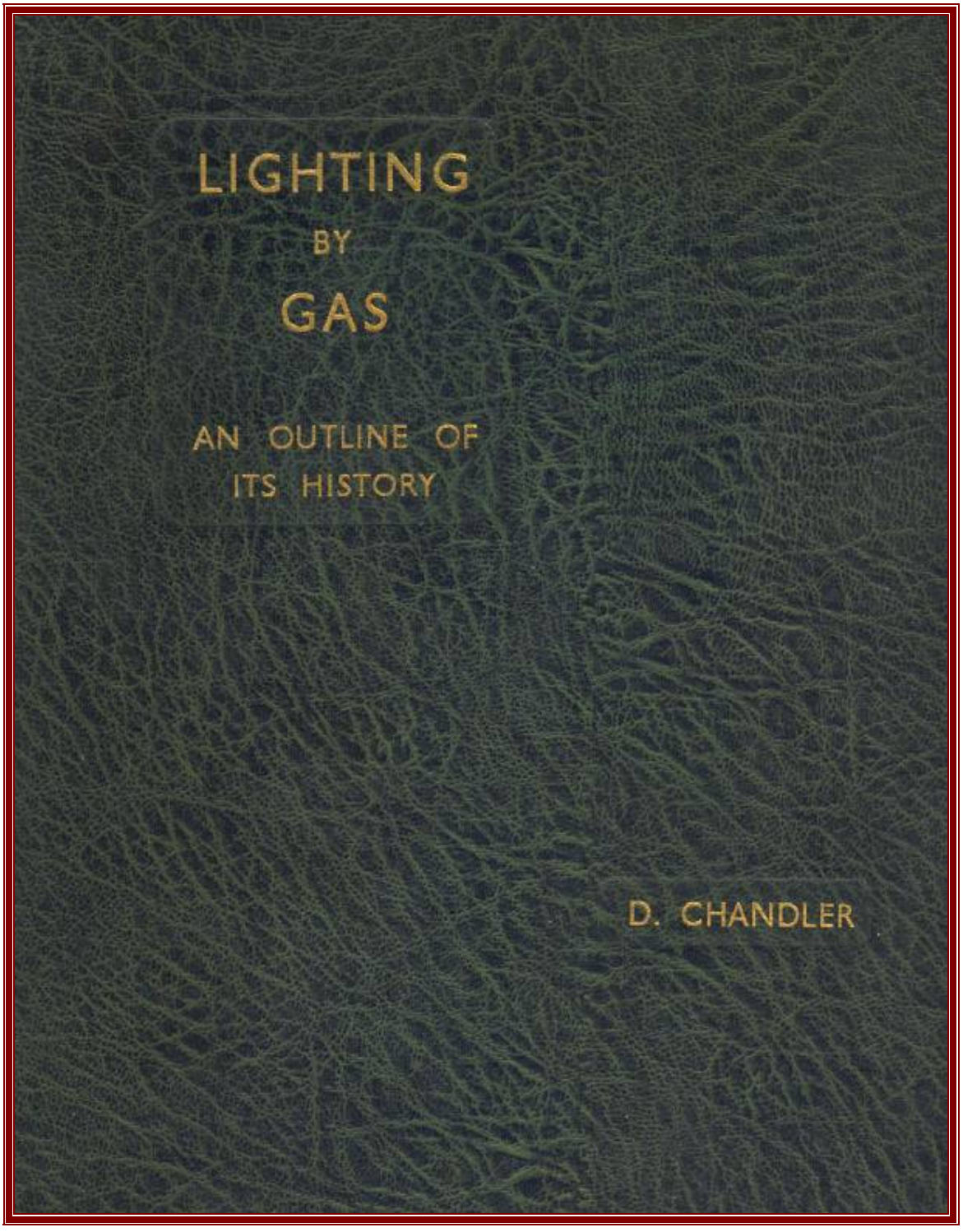
Unveiling Mort's Statue



Theresa and Thomas Mort

WILIAM MURDOCH (MURDOCK)
1754-1839

"The Father of Gas Lighting"



1936 (CIBSE Heritage Group Collection)

OUTLINE OF HISTORY OF LIGHTING BY GAS

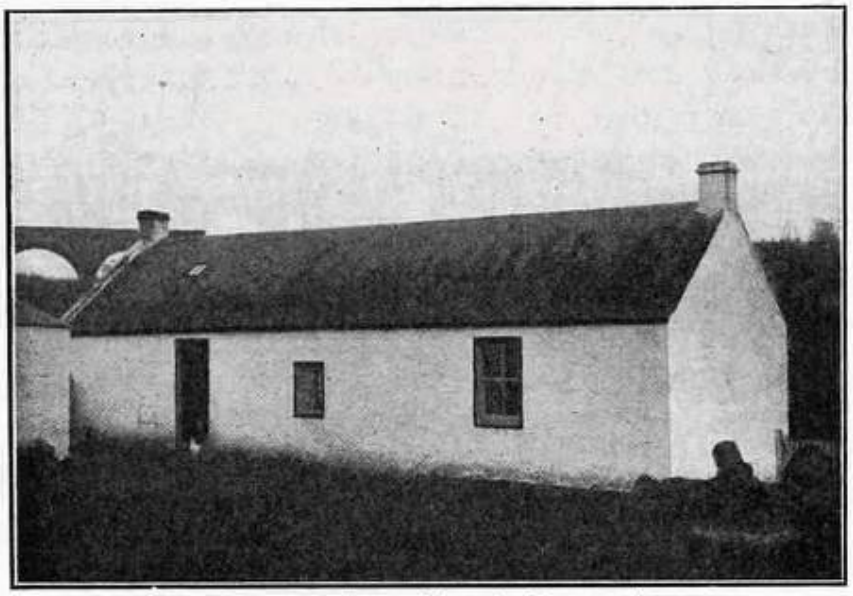
By

DEAN CHANDLER

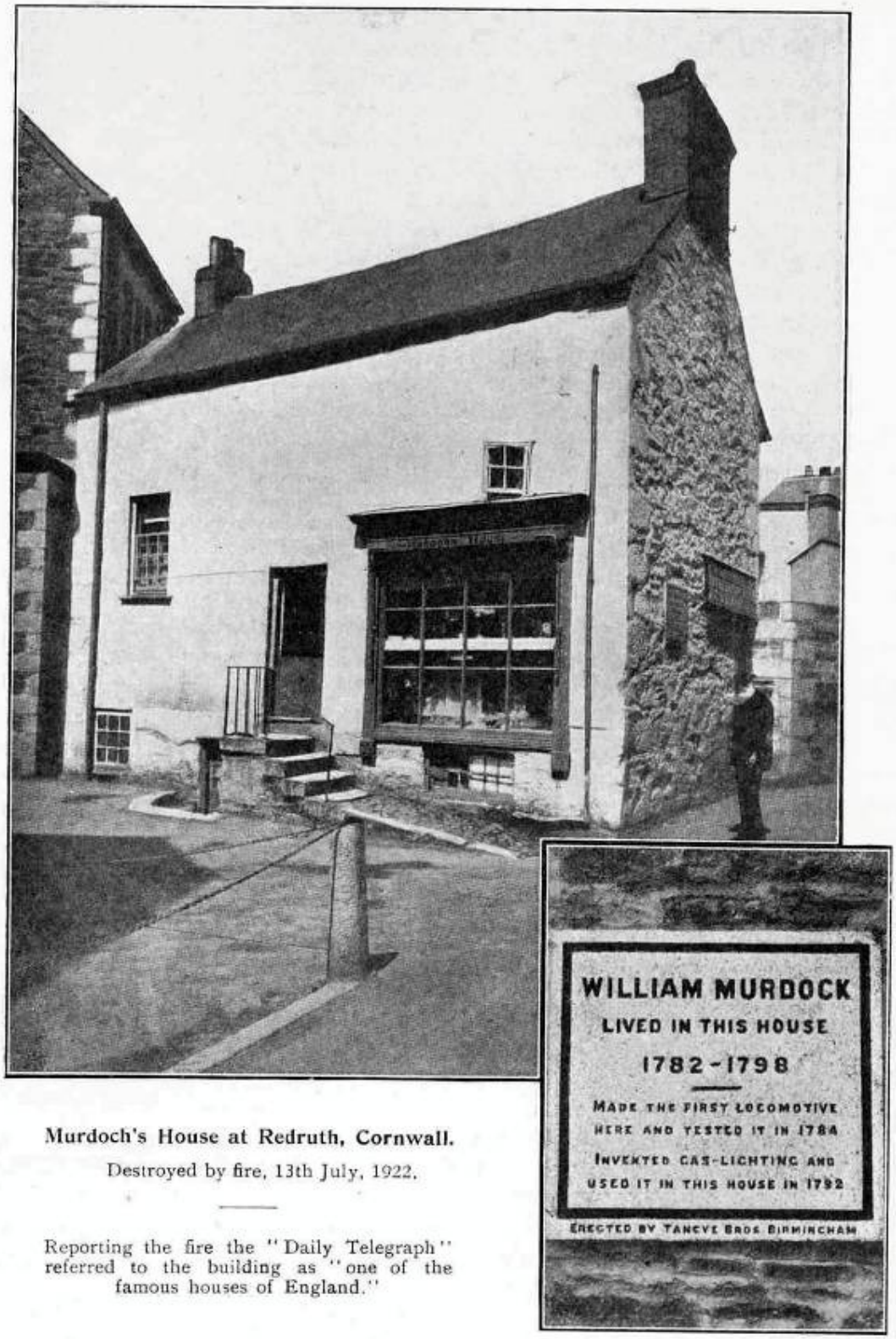
FOREWORD by

DR. CHARLES CARPENTER, C.B.E., M.Inst.C.E.
President of the South Metropolitan Gas Company

In 1792, Murdoch, at Redruth, lighted his offices and cottage with gas to the great wonder of the miners of the district. His experiments, however, had to be abandoned for five years—though he continued to use gas for lighting. In 1797, when he renewed his researches, he advised Watt to take out a patent for the invention, but Watt declined. Murdoch in the following year constructed at Birmingham an apparatus for the making, storing, and purifying of gas with a view to the supply of factories. Not long after this the offices of the works at Soho were lighted with gas, and the first public exhibition of the new illuminant was made in 1802, when the exterior of the factory was lighted up in honour of the Peace of Amiens. Having supplied Soho throughout with gas-burners, he contracted in 1805 with Messrs. Phillips and Lee, of Salford, to light up their factory. The burners employed were of two patterns; the one a kind of Argand, the other a small curved tube with a conical end having three circular apertures. Owing to the appearance of the flames, the workmen christened this light the "Cockspur." The economy of the installation was proved by the fact that with 271 Argands and 633 other burners, the cost was £600 per annum, against £2000 for candles. In regard to its efficacy, Murdoch stated that "the peculiar softness and clearness of the light, with its almost unvarying intensity, brought it into great favour with the workpeople; and it being free from the inconvenience of sparks, and the frequent necessity of snuffing, are circumstances of material importance, as tending to diminish the hazard from fire, to which cotton mills are so much exposed."



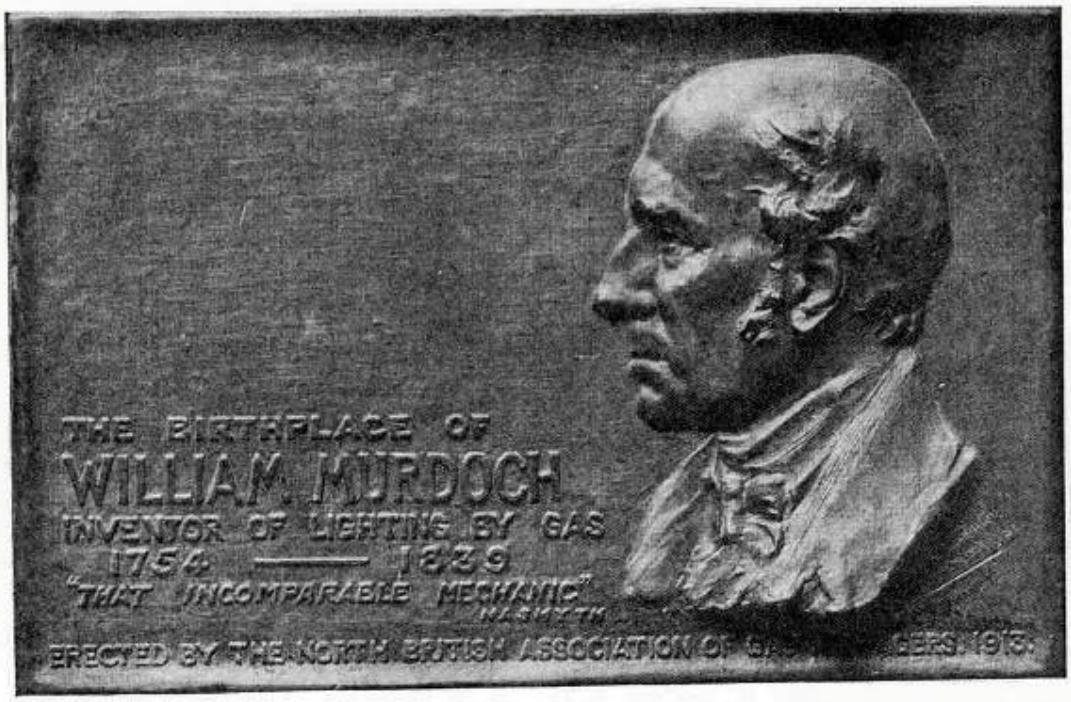
The House where Murdoch was born.
Memorial Tablet was placed in the wall of this house in 1913.



Murdoch's House at Redruth, Cornwall.

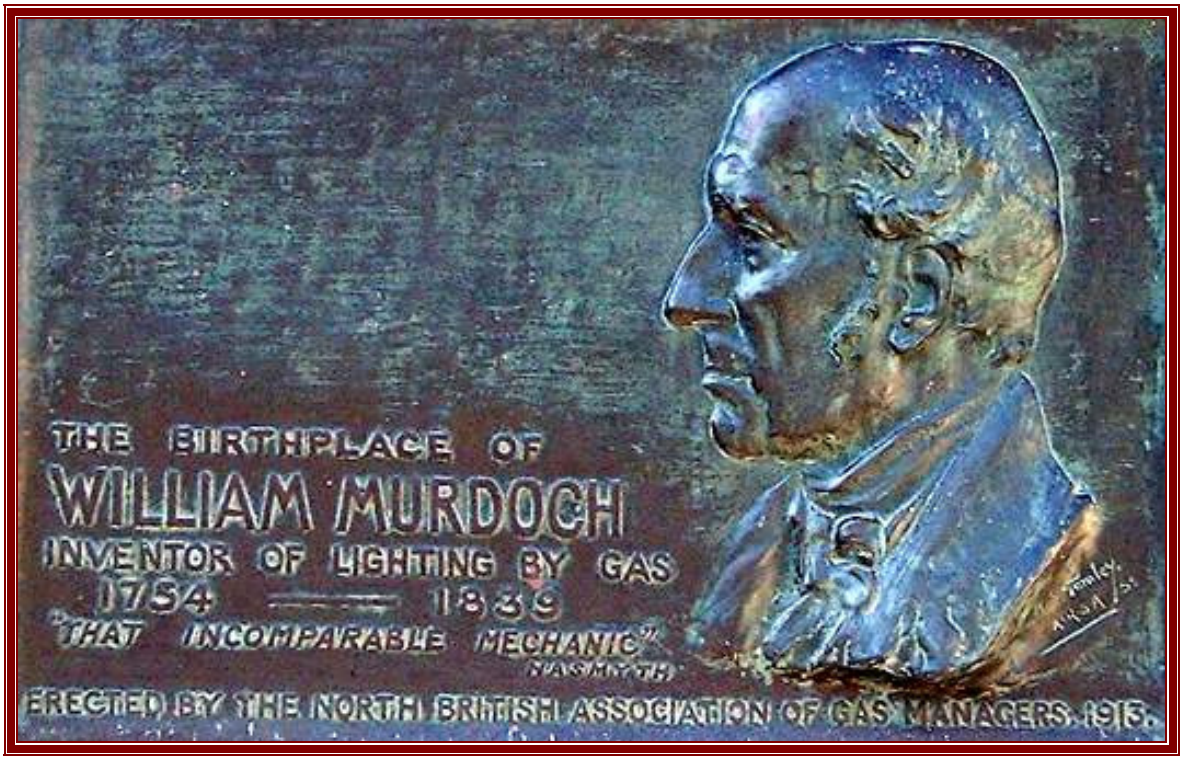
Destroyed by fire, 13th July, 1922.

Reporting the fire the "Daily Telegraph" referred to the building as "one of the famous houses of England."

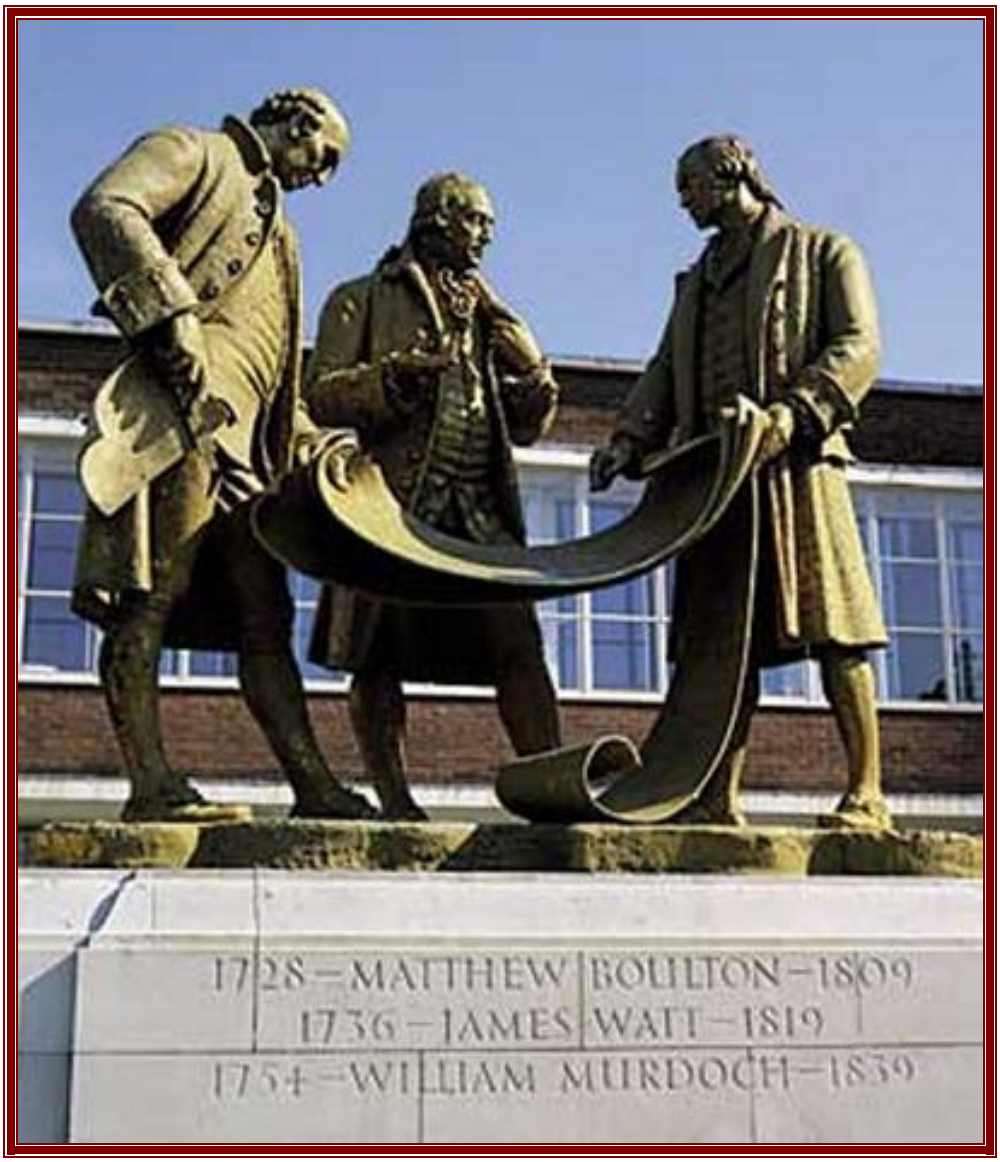


WILLIAM MURDOCH MEMORIAL TABLET.

Tablet placed in the wall of the house in which Murdoch was born. It was unveiled in 1913 in the presence of a large company of engineers.

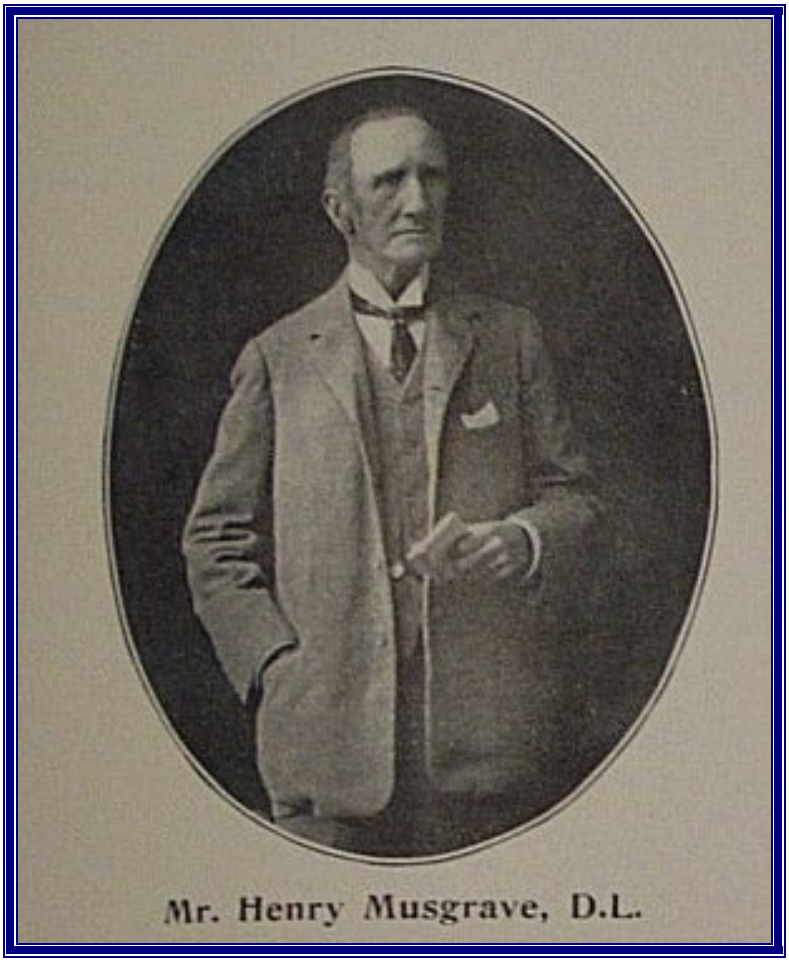


Portrait of William Murdoch



Statue in Birmingham

HENRY MUSGRAVE
1827-1922



Belfast stove manufacturer

A detailed biography is available elsewhere on this web site under
Victorian Heating Engineers *from which the following is an extract*

He served his apprenticeship with Mr William Finlay in the tea and wine business and had a long and successful business career in Belfast. About 1850 in partnership with his brother Edgar he established the business of H & E Musgrave, Ann Street. His public spirit was such that he did not neglect a fair share of public affairs. He had many business qualities and was the chairman of Messrs H & E Musgrave Ltd, Messrs Musgrave & Co Ltd, Messrs Riddels Ltd, Messrs John Riddel & Son Ltd and Messrs Murray Sons & Co Ltd. He was an active member of the Royal Ulster Agricultural Society and of the Belfast Chamber of Commerce, life governor and member of the board of management of the Royal Victoria Hospital, Governor of the Belfast Royal Academic Institution and one of the trustees of the fund for the better equipment of Queens College. His portrait hangs in the Examination Hall at Queens University.

He was a grand juror and Deputy Lieutenant of County Donegal and made High Sheriff in 1909 – 10. He had also been made a Deputy Lieutenant of the City of Belfast. He was lavish in his liberality. Many charities in the city benefited by his donations, which were as widespread as they were generous. In recognition of his services to the city on the 1st March 1917 he was made an honorary burgess of the City of Belfast. The casket containing the certificate of presentation bears the arms and motto of the family, with panels at the sides containing beautiful enamelled painted views, of Queens University, Medical Ward of the Royal Victoria Hospital, the City Hall and Drumglass House. He was the donor of the Statue of Brigadier-General John Nicholson to his native town Lisburn which stands in the Market Square. In connection with Queens University he presented to their Library a collection of 98 volumes of Irish Statutes extending from 1310 to 1831.

In most designs, a magazine of fuel was provided (the "Irish" stove ("Belfast" or Musgrave, 1857-8)), and the firepot was lined with a refractory material. This served both to improve the combustion and to prevent the outer surface from becoming too hot. In the Musgrave stove, the flue gases made two passes through a heat exchanger before discharge. Fresh air warmed by passage through the exchanger was fed into the room (Fig. 3.9).

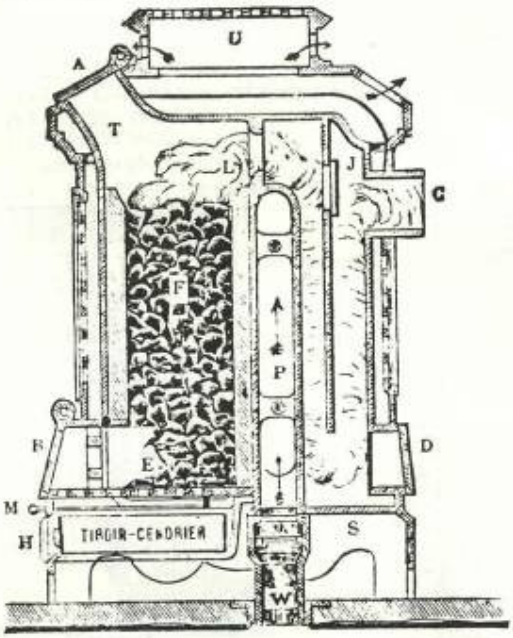
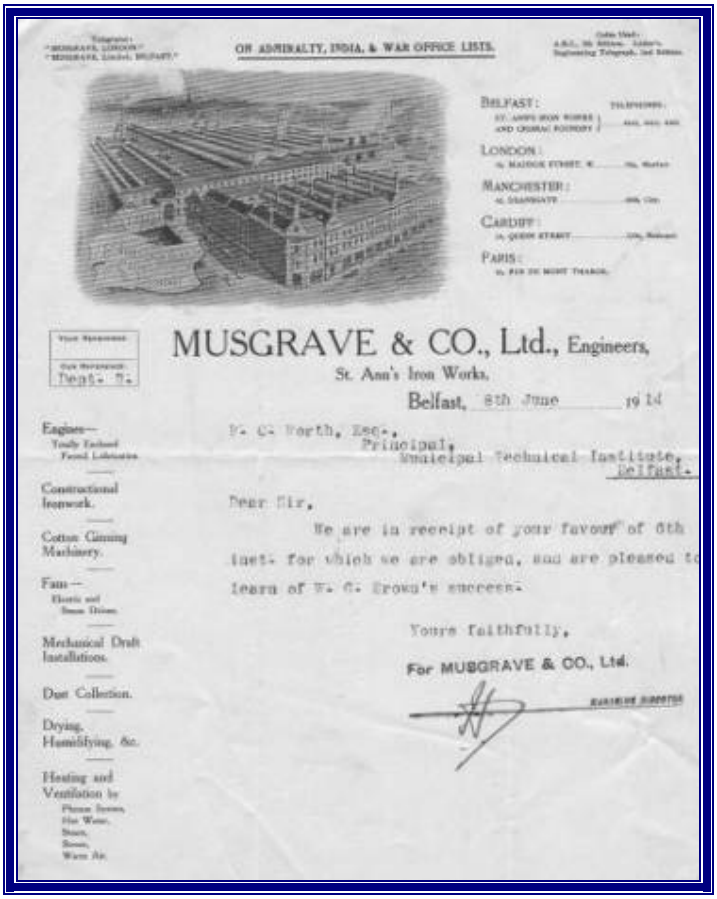


Fig. 3.9. Musgrave stove (Ireland)(1857).[29]

Inlet air controls, usually in the form of ashpit dampers, were also provided. Shaking grates to aid the removal of ash were frequently used. Special flueways were eliminated, the fuel bed itself serving to scrub the heat from the flue gases instead. The Brabo stove probably represents the most modern development of this particular form of stove.

(Extract from "Building Services Engineering," Neville S Billington & Brian M Roberts, 1982)



OF ADMIRALTY, INDIA, & WAR OFFICE LISTS.

BELFAST:
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MUSGRAVE & CO., Ltd., Engineers,
St. Ann's Iron Works,
Belfast, 8th June 1914

Dept. T.

Engines—
Totally Enclosed
Forced Lubrication

Constructional Ironwork.

Cotton Ginning Machinery.

Fans—
Electric and Steam Driven.

Mechanical Draft Installations.

Dust Collection.

Drying, Humidifying, &c.

Heating and Ventilation by
Plenum System,
Hot Water,
Steam,
Steam,
Warm Air.

W. C. Worth, Esq.,
Principal,
Municipal Technical Institute,
Belfast.

Dear Sir,

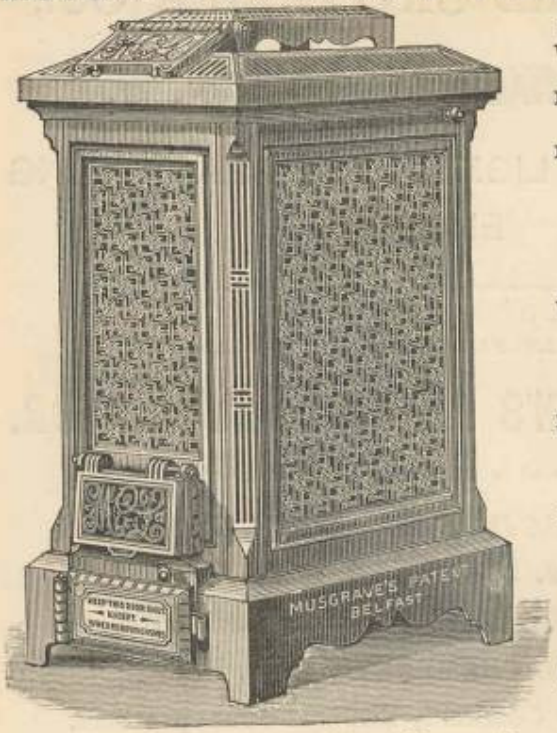
We are in receipt of your favour of 6th inst. for which we are obliged, and are pleased to learn of W. C. Brown's success.

Yours faithfully,

For MUSGRAVE & CO., Ltd.

Musgrave Works, Belfast and a letter of 1914

MUSGRAVE'S PATENT SLOW COMBUSTION "ULSTER" STOVES,



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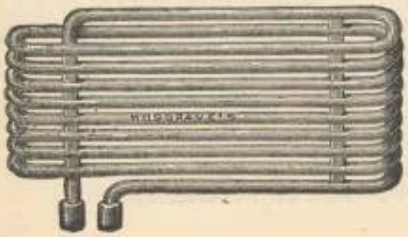

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40, DEANSGATE, MANCHESTER;

Ann Street, Ironworks, BELFAST;
240, Rue de Rivoli, PARIS.

Advertisement of 1897

MUSGRAVE & CO.
LIMITED.

Church Stoves.

No. 4. Design 12.

J. F. Hamlyn, East Portlemouth Rectory, Salcombe, S. Devon.

25/6 March, 1920.

a settlement of your account. My churchwardens as well as myself

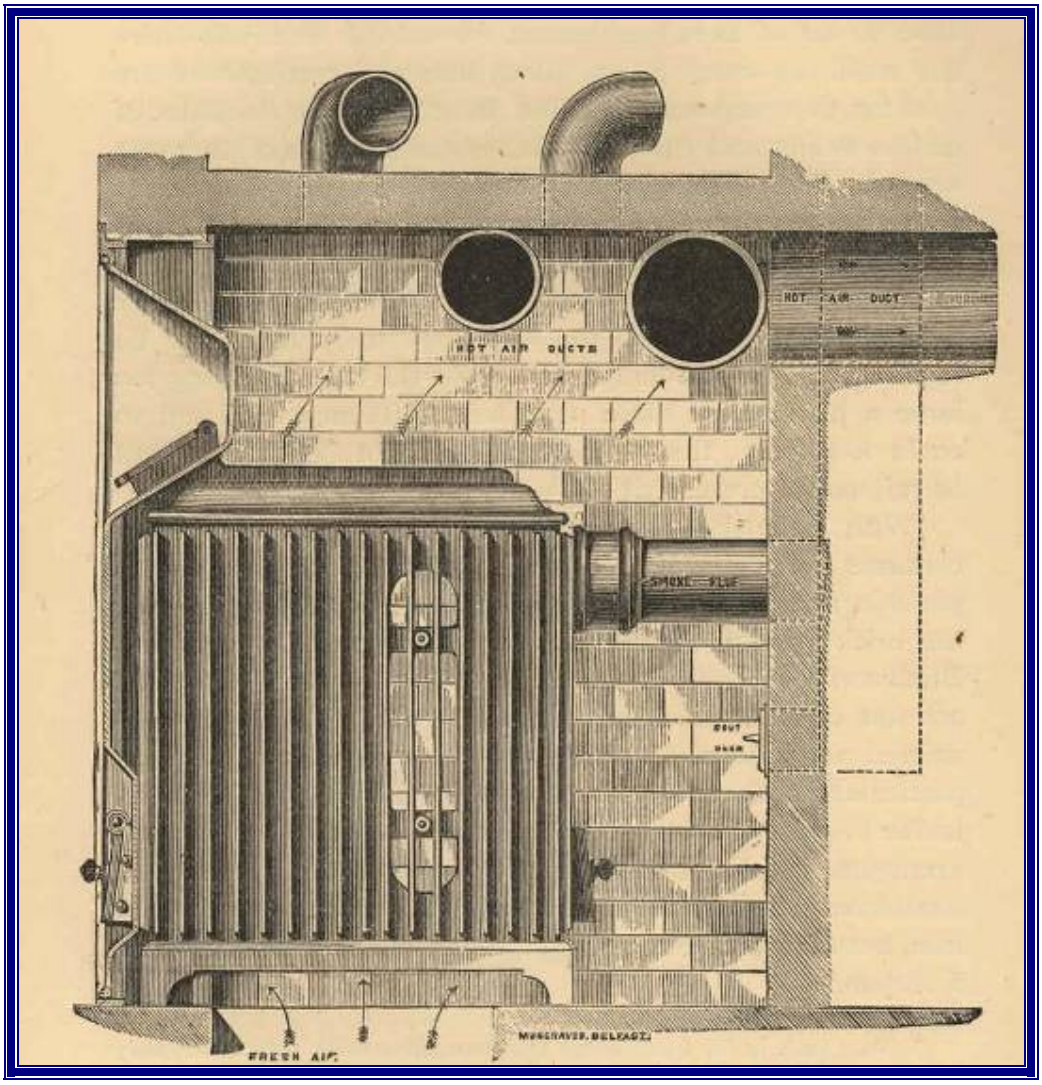
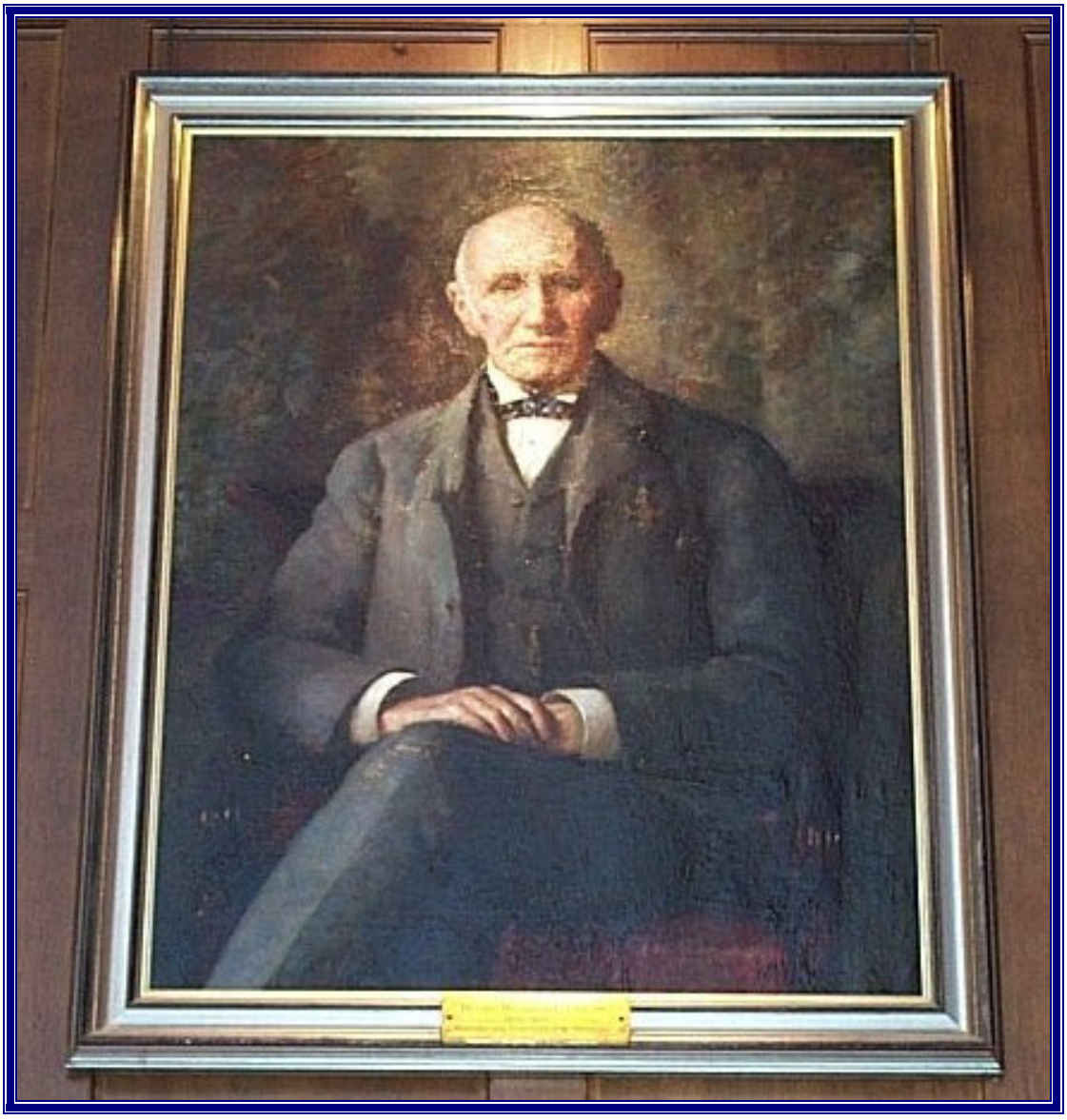
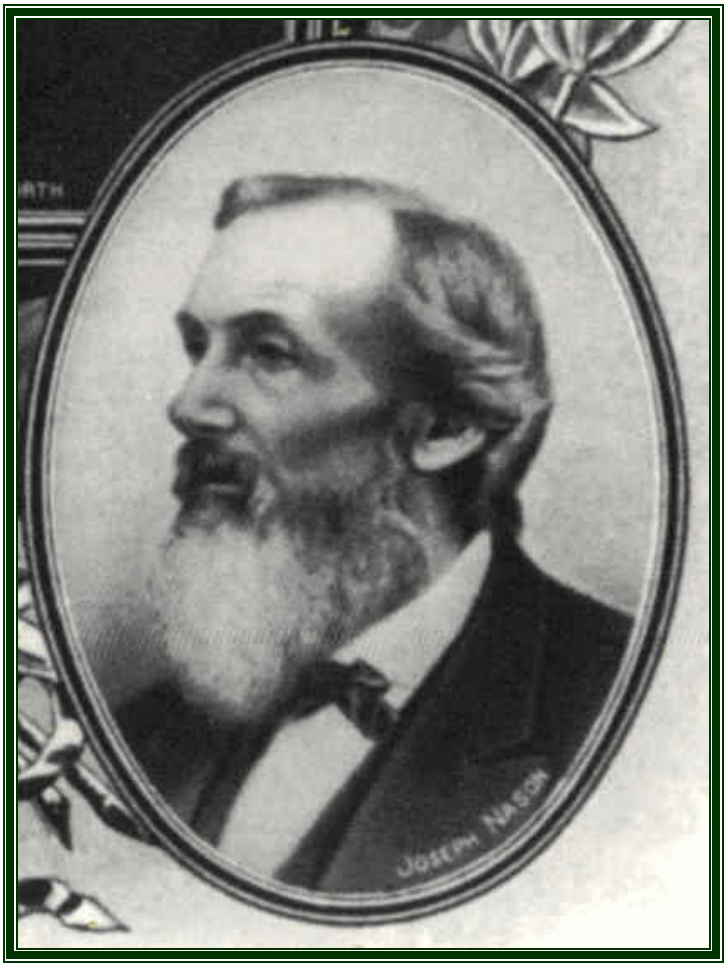


Diagram of Musgrave "Irish" Stove
(From "Hood on Warming Buildings," Fredk Dye, 1891)



Portrait of Henry Musgrave in Queen's University, Belfast, painted 1914

JOSEPH NASON
1815-1872



Said to have introduced steam heating to the USA

[206] Joseph NASON **1815-1872**

American heating and ventilating engineer. Worked for A.M. Perkins [224] in London. Also met Thomas Russell and (with James Walworth) bought Russell's unsuccessful New York business, founding Walworth & Nason (1841). Heated the counting room (1842) at Middlesex Mill, Lowell, Mass. Developed steam heating using small bore piping. Nason is credited with introducing steam heating into the USA at the Eastern Exchange Hotel, Boston (1845), and in the same year at a woollen mill in Vermont. He developed the *Nason Regulator* (1840s) to control steam pressures. The first application of a fan ventilating apparatus in the U.S. was by Walworth & Nason for the Boston Custom House (1846), where "the fan used was a paddlewheel like that used on steamboats which was mounted in a case fitting the ends of the blades with fair accuracy, but leaving area enough about the periphery to permit free escape of air." The installation used a "steam trap which had been invented by Mr. Nason...." Nason also built (1851) a small, upright water-tube boiler to replace the wrought-iron pipe coils typically used at that time. The partnership with Walworth was dissolved (1852) and Nason went to work in New York. Later (1855), at the request of Meigs [207], he planned, with Briggs [205], the heating and ventilating system for the United States Capitol in Washington, described as "the first really scientific and complete job of its kind done in the country." The installation used *trombone* heating coils of distinctive shape, specially designed by Nason. He introduced (1862) the *Nason* radiator.

(Mini-biography from "The Heat Makers," Brian Roberts, ASHRAE, 2000)

Middlesex Mill, Lowell, Massachusetts: Counting Room heated in 1845

Exchange Hotel, Boston: Steam heating introduced into USA 1845

The Boston Custom House: fan ventilating apparatus 1846

Burlington Mill, Vermont

US Capitol, Washington: as it was in 1846

In the middle of the nineteenth century, steam heating became the popular method of warming buildings in Europe and the United States. The introduction of steam heating to the United States is credited to Joseph Nason (1815-1872), who, through the firm of Walworth & Nason, was the first to demonstrate the use of steam as a practical means of heating. While traveling to London, Nason met Angier Perkins and worked for a period of time in his heating business. Through Perkins, he met with Thomas Russell (of the pipe manufacturing family), who had attempted unsuccessfully to start a business in New York City. Russell sold his stock to Joseph Nason and a partner, James Walworth. With this, the firm of Walworth & Nason began in June 1841. In 1842, Walworth & Nason moved to Boston where their first commission was to heat the "counting-room" of the Middlesex Mill in Lowell, Massachusetts (Figure 7-20).

The firm developed steam heating systems using piping of smaller diameter. The first steam heating installation was in 1845 for the Eastern Exchange Hotel in Boston. The heating of the rooms was accomplished by pipecoils, predecessors to the cast-iron radiators that replaced them later in the century. That same year they installed steam heating for a woolen mill in Burlington, Vermont.

The first application of a fan ventilation apparatus in the United States was by Walworth & Nason on the Boston Custom House in 1846.

> The amount of the contract was $6,750. . . . The fan used was a paddlewheel like that used on steamboats which was mounted in a case fitting the ends of the blades with fair accuracy, but leaving area enough about the periphery to permit free escape of air. The air was heated by coils of 3/4 inch pipe, the water of condensation being discharged through a Nason steam trap which had been invented by Mr. Nason for use with heating apparatus, a sufficient pressure being carried on the boiler to run the small steam engine that drove the fan, the exhaust steam being used to heat one of the coils.[24]

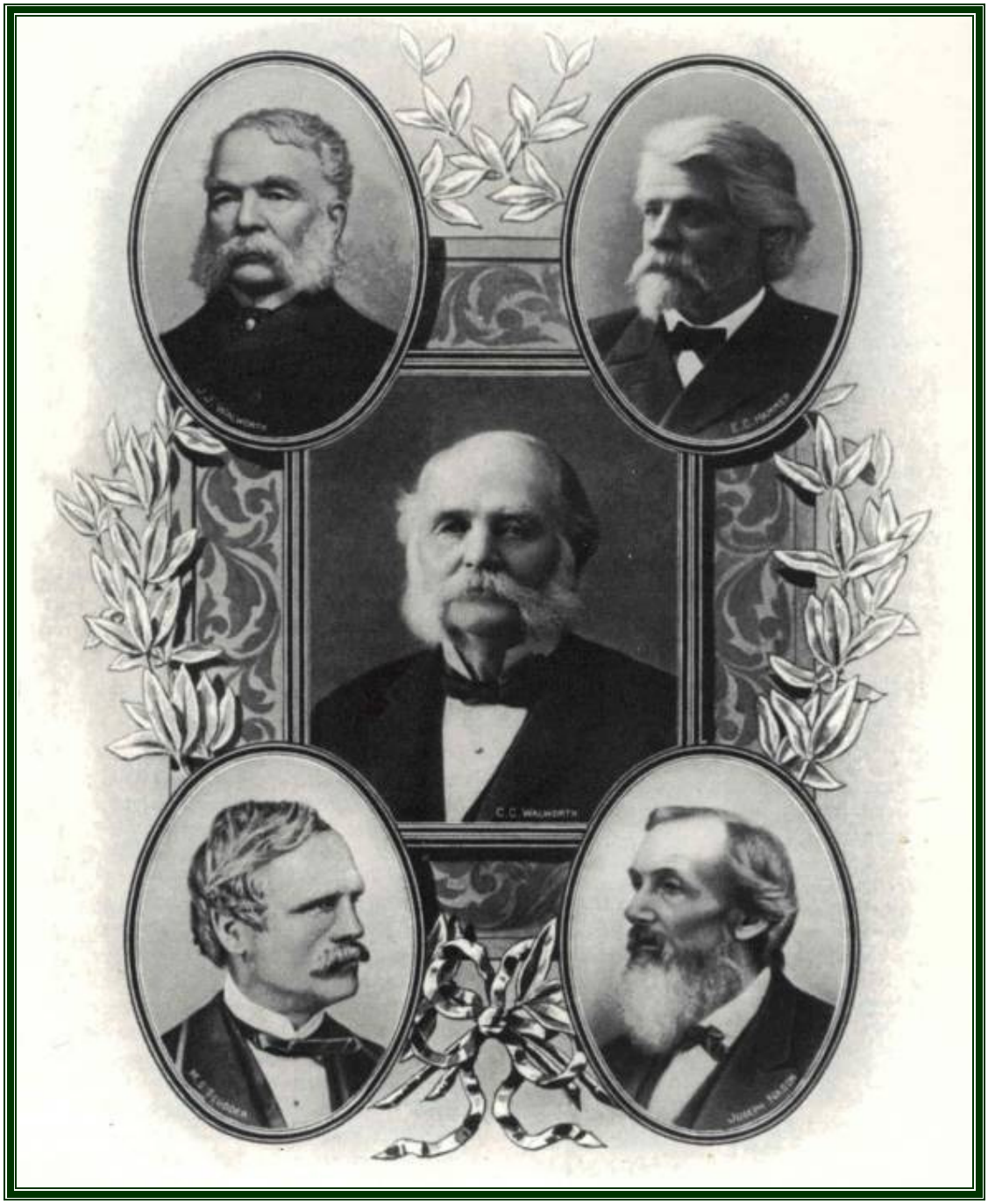
Joseph Nason constructed a small, upright water-tube boiler in 1851 to take the place of the coils of wrought iron pipe that was typical of the earlier work of Walworth & Nason. In 1852, the partnership between Nason and Walworth was dissolved. Joseph Nason went to New York to manage the firm's business there.

In 1855, Nason, at the request of Captain Montgomery C. Meigs, planned the heating and ventilating system for the United States Capitol, which has been described as "the first really scientific and complete job of its kind done in the country."

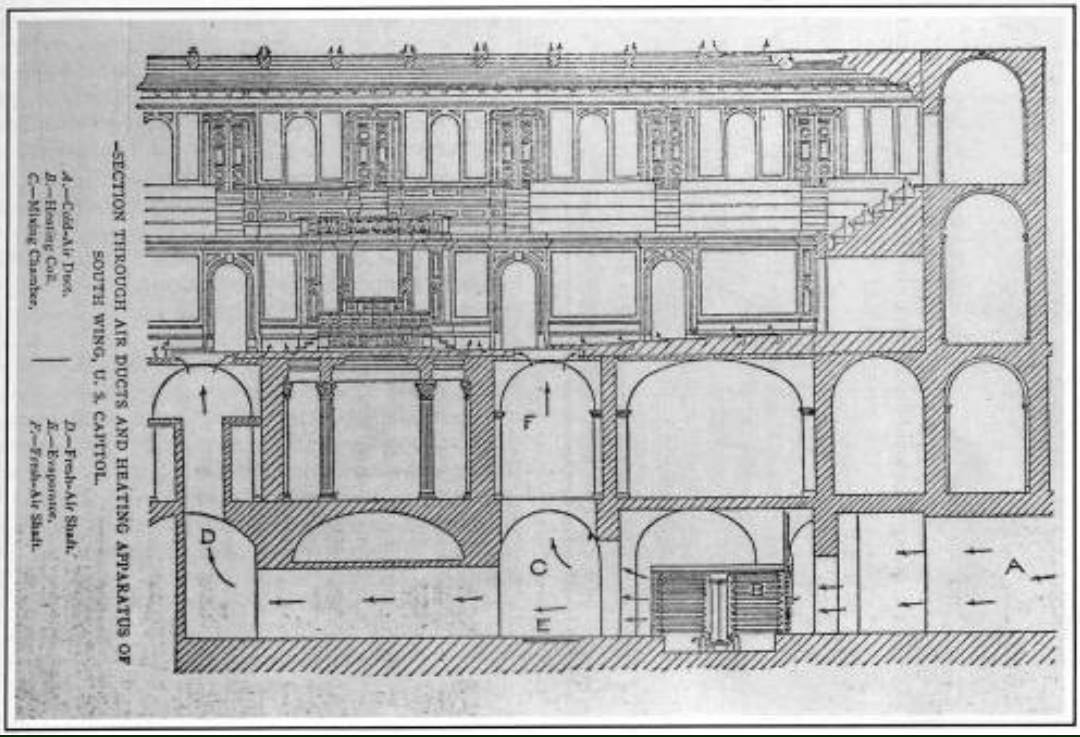
General Montgomery C. Meigs, who was responsible for coordinating the overall design and installation of the first heating and ventilating system in the U.S. Capitol, worked closely with Robert Briggs, a consulting engineer from Boston, and Joseph Nason from New York. The heating and ventilating systems were used in the south and north wings of the Capitol for the House of Representatives and the Senate, respectively. The systems included heating and ventilating for the legislative chambers of the House and Senate, as well as the numerous committee rooms, corridors, and the "great stairwells."

At the Capitol the system recommended and adopted was that of a forced or plenum ventilation, the entering air being propelled by two large centrifugal fans, one 16 ft. and one 12 ft. in diameter, motive power being applied to the fan by vertical engines, the cranks of which were keyed on to the fan shaft. The volumes of air to be moved were much larger than had been handled in earlier work and a more refined analysis of the form and construction of the fan than previously had been made was deemed advisable, and, therefore, a long and costly series of experiments were made by Mr. Nason, in cooperation with Captain Meigs as to the best possible obtainable form for the fans. These fans as built were really air turbines reversed. They consisted of circular iron discs of diameters mentioned above on the periphery on one side of which were bolted cast-iron quadrilateral vanes.

(Text from "Heat & Cold: Mastering the Great Indoors," Barry Donaldson & Bernard Nagengast, ASHRAE, 1994)

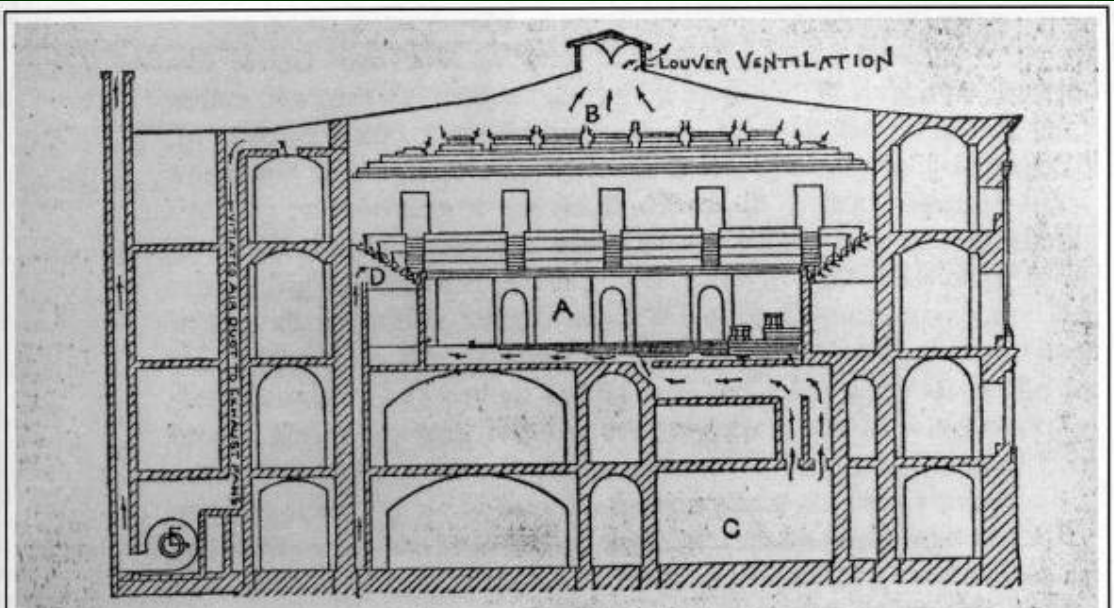


Pioneers of Walworth Manufacturing Company
(Centre) C C Walworth: (Bottom right) Joseph Nason



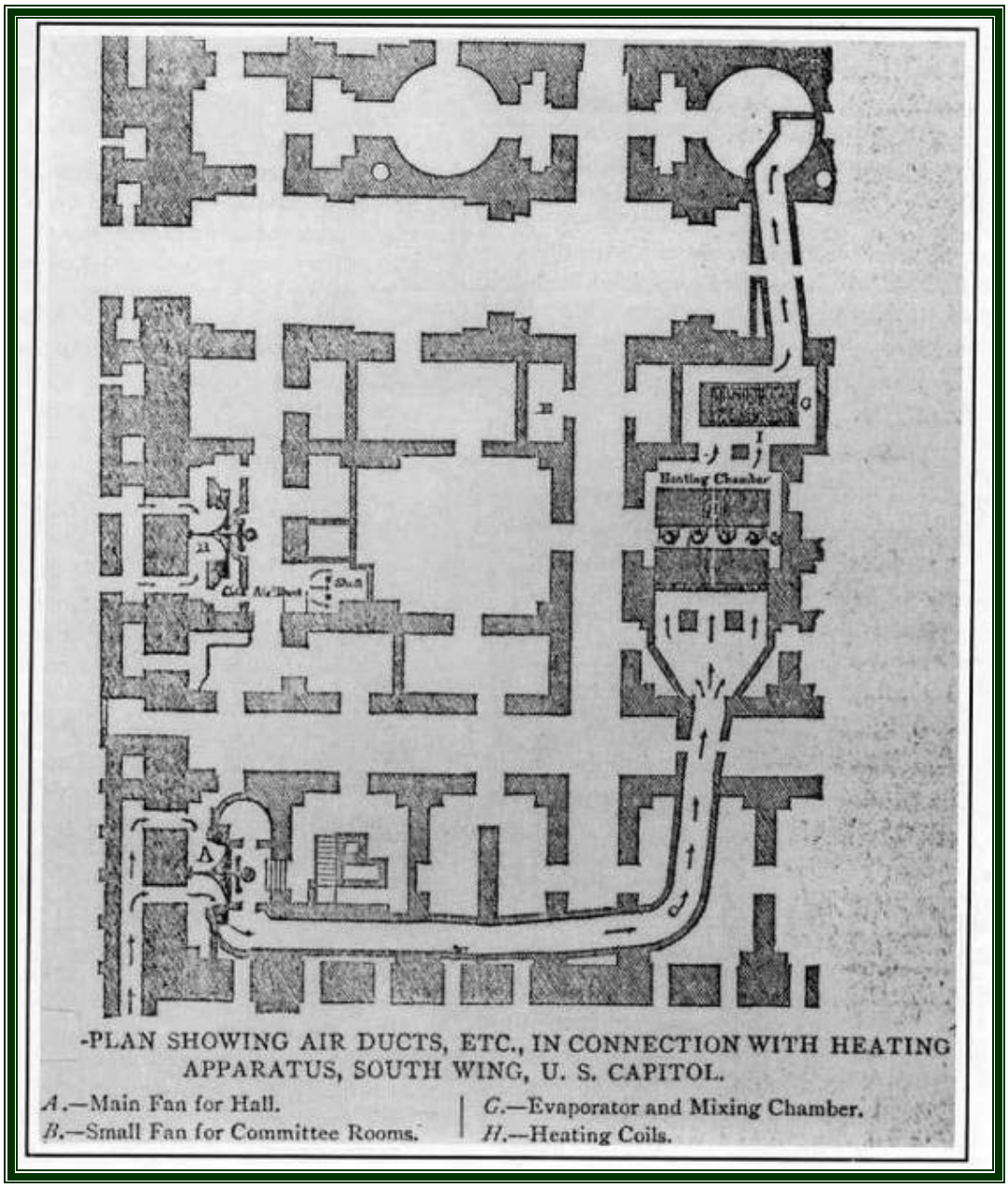
—SECTION THROUGH AIR DUCTS AND HEATING APPARATUS OF SOUTH WING, U. S. CAPITOL.

A.—Cold-Air Duct.
B.—Heating Coil.
C.—Mixing Chamber.
D.—Fresh-Air Shaft.
E.—Evaporator.
F.—Fresh-Air Shaft.

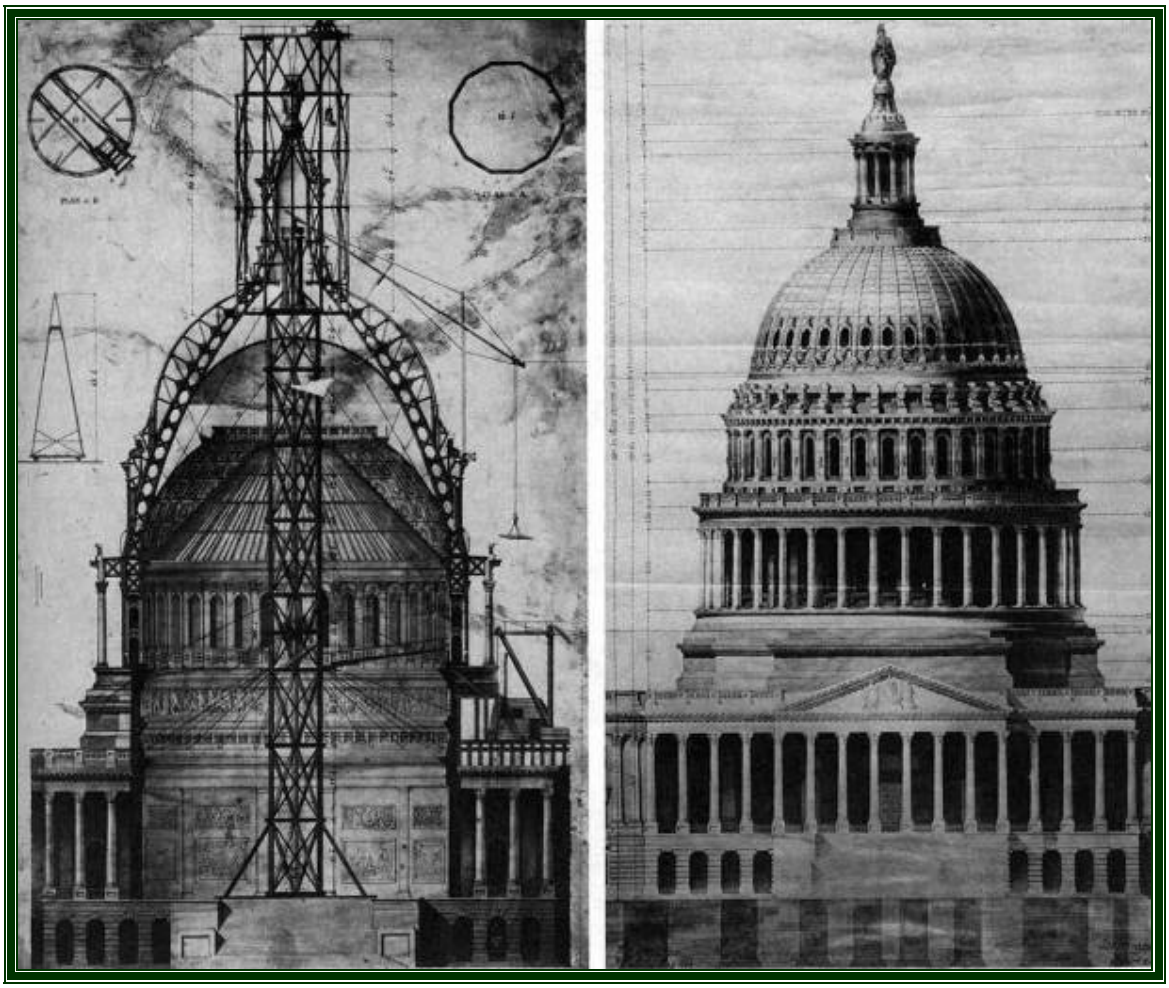


—TRANSVERSE SECTION THROUGH SOUTH WING, U. S. CAPITOL.

A.—Main Hall.
B.—Space over Hall.
C.—Main Fresh-Air Duct.
D.—Fresh-Air Supply to Galleries.
E.—Exhaust Fan.



(Capitol drawings from "Ventilation and Heating," John S Billings, 1896)



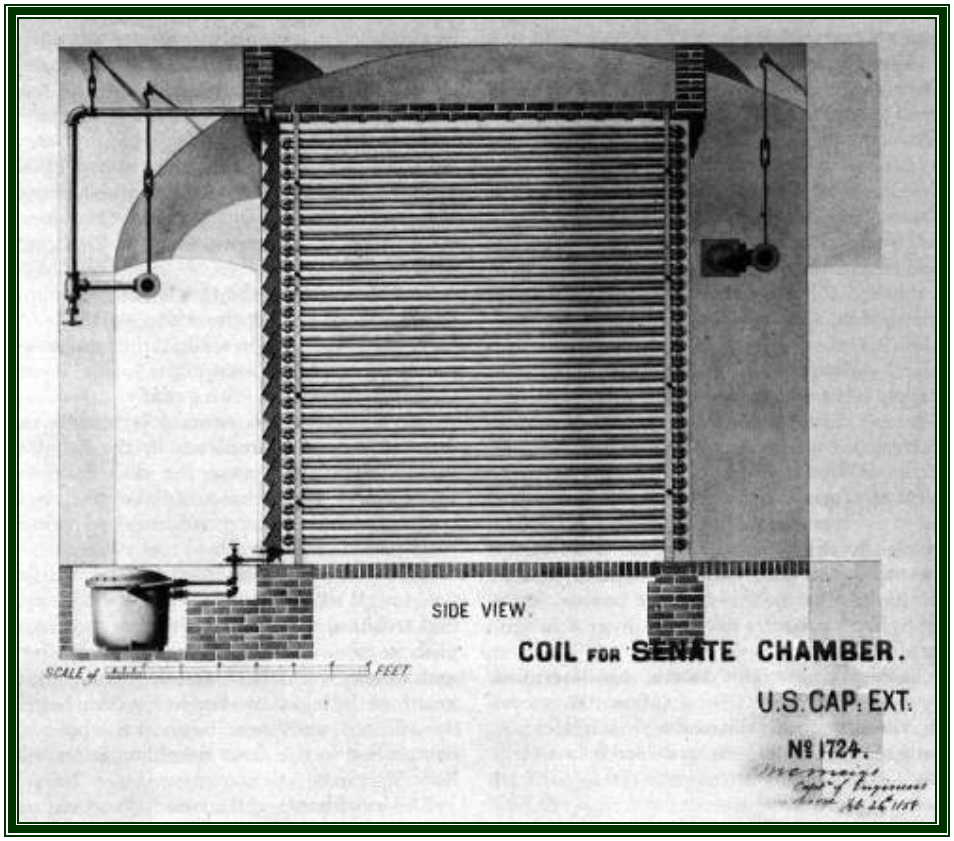
"The Great Iron Dome" of the Capitol
(From "Building Early America," Charles E Petersen (Ed), 1976:
Chapter 12 "Building the Capitol," Mario E Campioli)

(Following text & pictures from "Building Early America," Charles E Peterson (Ed), 1976: Chapter 10 "An Historical Sketch of Central Heating: 1800-1860," Eugene S Ferguson)

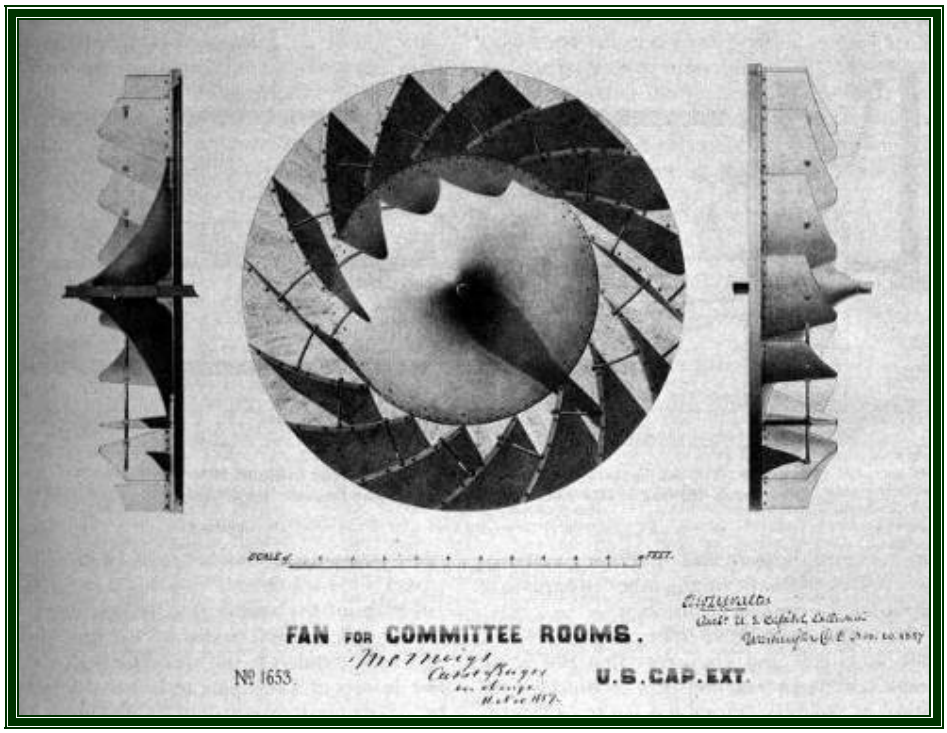
After the basic decisions as to arrangement of rooms in the new wings of the Capitol had been made, Constructor Meigs called Joseph Nason to Washington to discuss the requirements of the new buildings. Meigs told Nason that he wanted "something more than a mechanic—one who has some scientific knowledge, so as to be able to appreciate the scientific discussions of the subject which have been published abroad, and to apply the principles they unfold with mechanical skill and practical knowledge, enough to lay down his system of pipes without error."[48] Nason proposed to supply all necessary pipe and fittings at fifteen per cent discount from printed list prices, to furnish an engineer and draftsman for six dollars a day, and first and second class workmen at proportionate rates. Nason's services, as consultant, were supplied at no extra charge to the purchasers of his pipe. Meigs promptly accepted Nason's proposal; design of the intricate system of steam boilers, steam coils, brick-masonry ducts and huge centrifugal fans began in the fall of 1855. Because no reliable data were available to determine power requirements of the fans, Meigs ordered immediately the making of a model fan, on a scale of 10 to 1, to be driven by a weight on a cord, falling through a distance of 50 feet.[49]

Nason's general approach to the heating of the new wings was to blow air across nests, or coils, of pipe containing steam at low pressure (Fig. 10.17). The heated air was then carried through ducts, divided and subdivided to reach every part of the rooms to be heated and ventilated. Pipe for the coils was wrought iron, slightly larger in size but otherwise the same as that used in the Perkins high pressure system.[50] In the House of Representatives wing, twenty-two heating coils were provided, each comprising over a thousand lineal feet of pipe. Four boilers supplied steam to the coils and steam to drive the two fan engines; two enormous fans—the larger some 16 feet in diameter—were required, one for the House chamber and one for all the other rooms in the wing (Fig. 10.18). An equivalent system was installed in the north, or Senate, wing.[51]

The detailed design of the fans was based on a study by Robert Briggs, Jr., of the data collected from the model fan and dynamometer, mentioned earlier.[52] Briggs was the "engineer and draftsman," furnished as part of the piping contract, who was to become a recognized authority on heating and ventilating, reinforcing in the next generation the Nason approach.[53]



Heating Coil, US Capitol, 1858



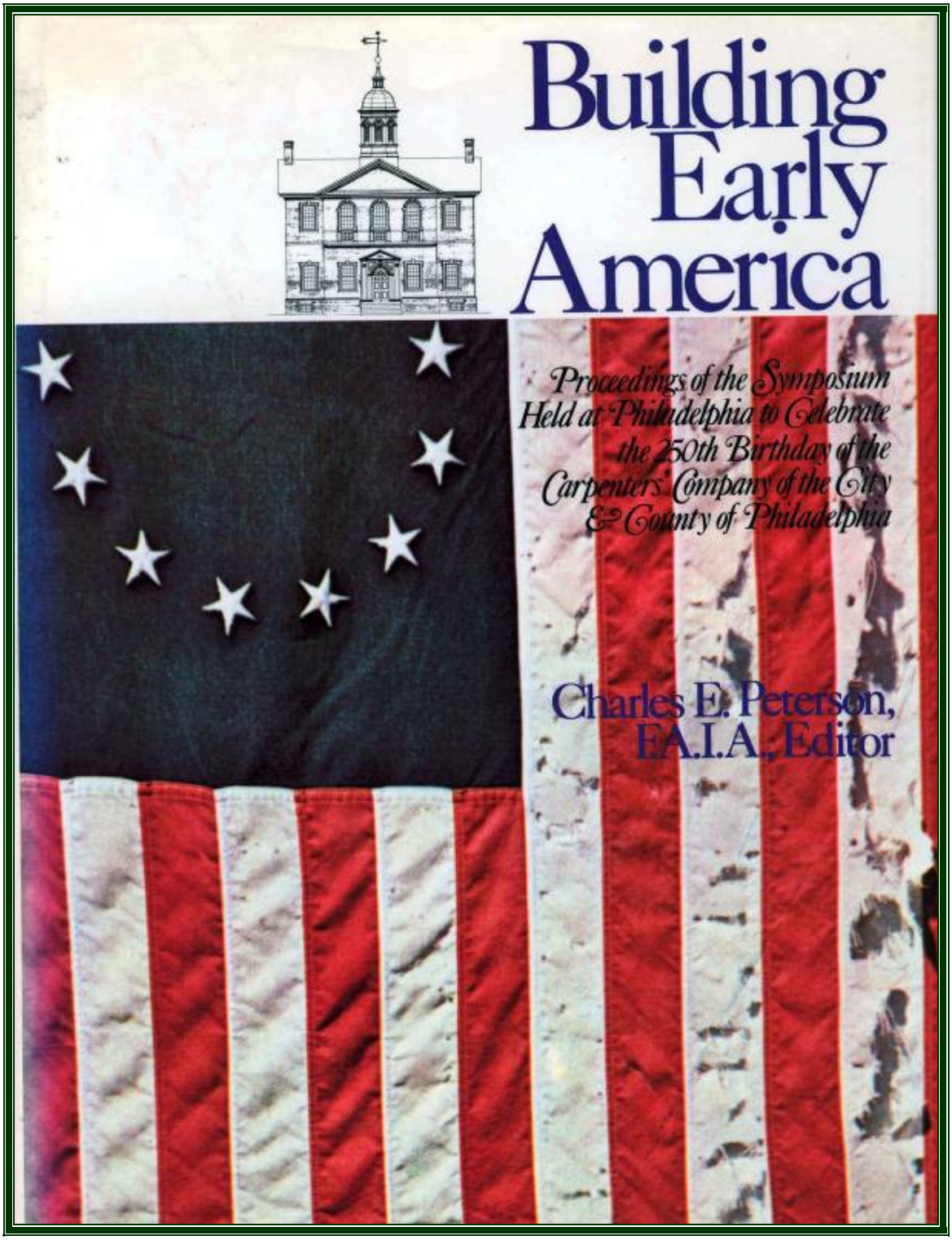
Fan rotor, US Capitol, 1857

NASON'S
"STANDARD" WROUGHT IRON TUBE RADIATOR

Nason introduced an innovative radiator design in 1862, "built of pipes screwed into a cast-iron base and so adjusted that each pipe and the base for it contained exactly one square foot of superficial surface. This radiator was the first to be constructed on strictly scientific lines and I think it can be fairly stated that all radiator ratings in use today in this country are primarily based upon the Nason radiator."[31]

> In this way, from 1862 to 1879, the vertical-pipe wrought-iron radiator business fell into the hands of concerns of great capital and great business ability. These were the men who had the inventive power and the business capacity to make the steam-heating development in this country in those 17 years one of the business marvels of the nineteenth century. After the close of the Civil War, the heating-business began to attract the attention of the manufacturers of cast-iron.[32]

The firm of Walworth and Nason continued to thrive during the next thirty years, designing and installing steam heating and fan-powered ventilating systems in many large projects throughout the northeastern United States. Walworth and Nason ultimately merged into "the great manufacturing concern" known as the Walworth Manufacturing Company.



Reference Book 1976 (CIBSE Heritage Group Collection)