FRANK J DEAN Jr
1911-2000

Pioneer in VAV Air Conditioning

FRANK J DEAN Jr **1911 - 2000**

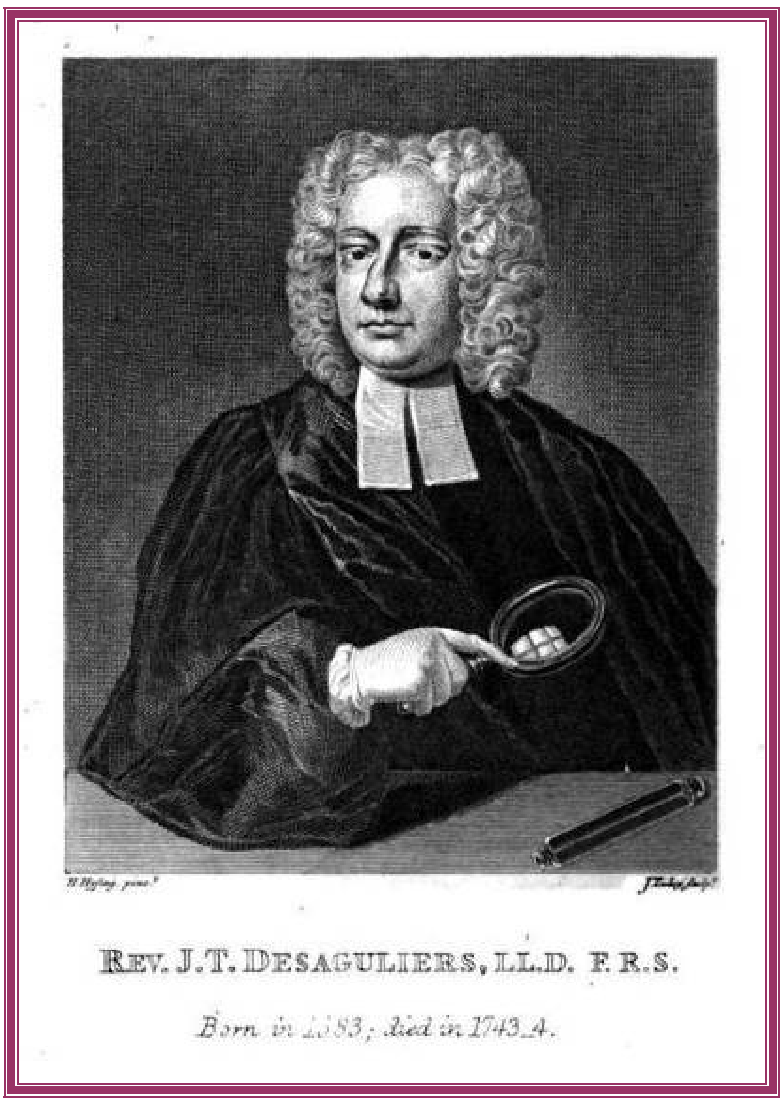
Frank J Dean Jr. received a degree in Mechanical Engineering from Princeton and a Masters degree from MIT in Mechanical Engineering. Dean conceptualized and implemented an overall method of designing and installing air-conditioning systems that provided a unique combination of low first cost and low energy cost without sacrificing high quality. His designs also provided for quietness, durability and low maintenance. Among his innovative concepts was the development of a computerized air-conditioning system simulation program using weather data together with detailed equipment and systems modelling. These programs were installed in the Kansas City Board of Trade Building in 1966 and continue to perform satisfactorily today.

Dean was one of the first installers of variable-air-volume (VAV) systems and stands out in perfecting the total system concept. It is estimated that nearly 70 percent of large commercial air-conditioning systems in the United States today use the VAV system in some form. He formed the Temperature Industries Corp. along with subsidiary companies, Temperature Engineering, Tempmaster, Viron and Wattmaster. Temperature Engineering designed, installed, and serviced air conditioning systems in Kansas City and Detroit. The Tempmaster Corp. manufactured a line of commercial VAV air distribution products and air handling equipment. The Viron Corp. providing management consulting services, and the Wattmaster Corp. manufactured building automation control systems, all as a complement to Tempmaster equipment. The five companies worked together to pioneer cutting edge design, manufacturing and energy management systems solutions for the commercial HVAC marketplace.

Dean and his employees were granted more than 20 patents. Many equipment manufacturers in the US have successfully adopted many of the air-conditioning technologies and designs that he conceived and developed. Frank J Dean Jr has been inducted into the ASHRAE Hall of Fame

(Edited extract from ASHRAE "Hall of Fame" Citation)

JOHN THEOPHILUS DESAGULIERS
1863-1744



Inventor of the "Fanning Wheel"

[52] John Théopile DESAGULIERS **1683-1744**

French/English physicist and engineer. Experimenter in many fields, including electricity, where he is said to have been the first to use the word *conductor.* Translated the work of Gauger [54] in the book *The Mechanism of Fire Made in Chimneys* (1716). Introduced a *Fanning Wheel*, similar to those described in Saxon mines by Agricola [51] for ventilation at the Royal Society, London (1734), having previously (1727) made a fan for the Earl of Westmoreland "to clean foul air out of mines." Went on to apply his fan engine to ventilate the House of Commons (1734-1736): "a Committee was appointed to order me to make such a machine, which accordingly I effected, calling the Wheel a centrifugal, or blowing Wheel, and the Man that turn'd it a Ventilator." This apparatus was a wooden paddle wheel 7 ft in diameter with radial blades 1 ft wide in a wood casing with rectangular ducts and remained in use for many years (until 1791).

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

4.5.3. *Desaguliers' "fanning wheel"*

The mechanical fan, or "fanner" as it was originally called, was invented in 1734 by Dr Desaguliers, specifically for ventilating purposes. His original model was no more than a paddle wheel within a circular casing. The paddles or blades were 0.3 m broad and the wheel had a diameter of 2.1 m.

> "The wheel H was enclosed in a concentric case B, which had a 'blowing pipe' m on the upper part of its circumference, and a suction pipe S, that communicated by a funnel d, with the central opening in the wheel, which was turned by a handle A, attached to the axis that went through the case and rested on a standard. The 'fanner' was adjusted to revolve easily, but as closely to its concentric casing as possible, and it had no communication with the air except through the suction and blowing pipes. By the revolution of the wheel, the air entering through the central opening into the spaces gg, formed by the radiating partitions, was thrown by the centrifugal motion towards the circumference, where it was confined by the concentric casing, and carried round until it arrived at the opening of the blowing pipe m, into which it was impelled by each radiating partition in continuous revolution" (Fig. 4.19).

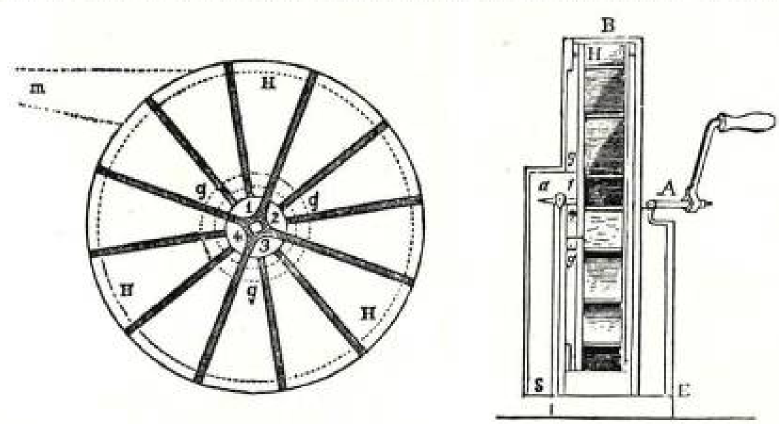


Fig. 4.19. Desaguliers' fan.

He envisaged the fan being used either to supply or to extract air from a room, or merely to keep the air of the room in motion. One of his fans was installed in the House of Commons in 1736, where it remained in use until 1817.

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

The publication of *La Mechanique du Feu* in 1713 by Nicolas Gauger and its English translation in 1716, *The Mechanism of Fire Made in Chimneys* by Dr. John Theophile Desaguliers, may have been the first discussions of the physical properties of air and theories for the heating and ventilating of buildings. Based on many of the methods and experimental principles laid down in *La Mechanique du Feu*, Desaguliers introduced a fanning wheel in 1734 at the Royal Society in London. Similar to those in the sixteenth-century mines of Saxony, the fanning wheel was to "show how damp or foul air may be drawn out of any sort of mines."[10]

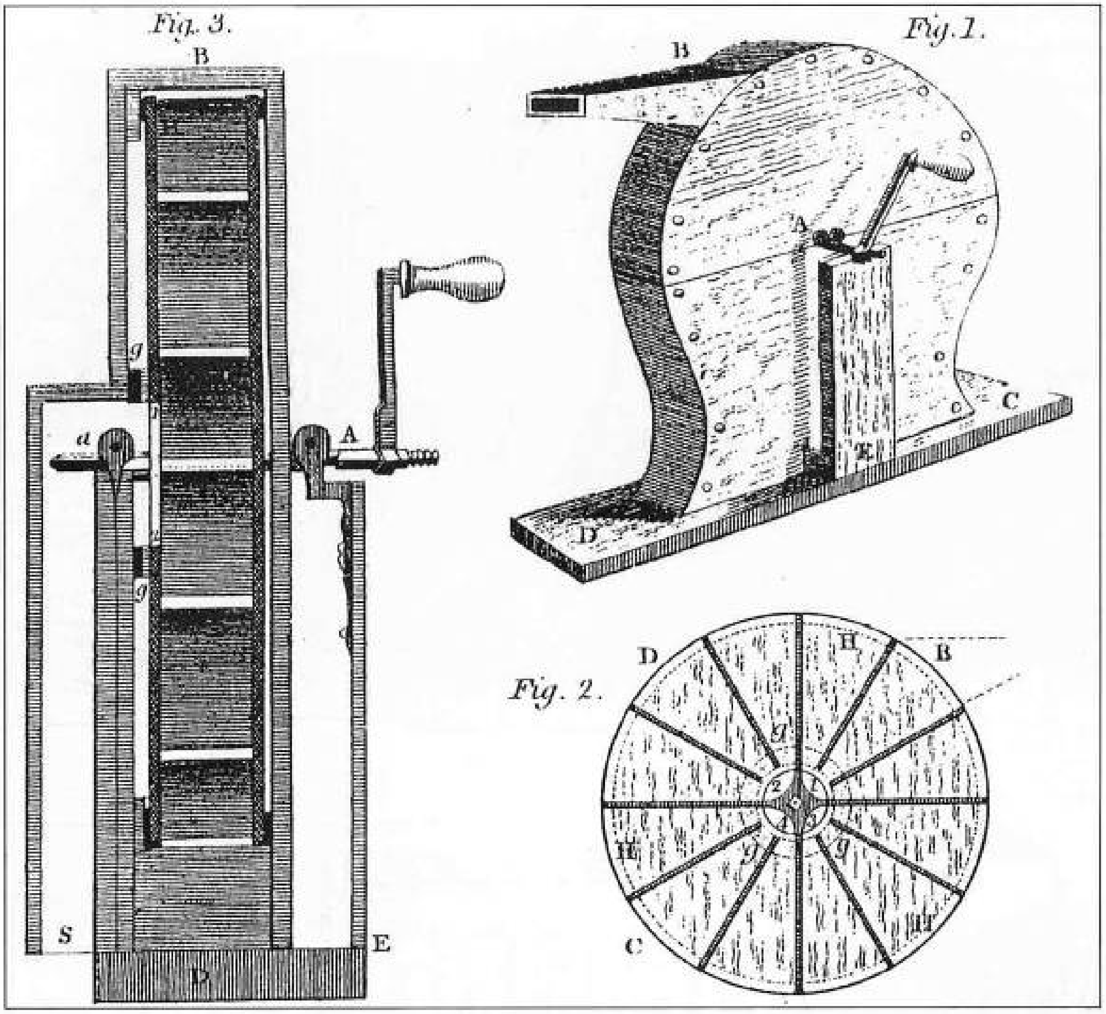
In fact, Desaguliers' design was originally made in 1727 for the Earl of Westmoreland to clean foul air out of mines. "The engine worked with a great deal of ease, and there being little atmospheric pressure or weight to be removed, and only the resistance from friction in giving moderate velocity to the air in the pumps, one man was able to discharge 10 cubic feet in a minute."[11] From 1734 to 1736, he applied his fan "engine" to ventilate the House of Commons. Desaguliers' design for the House of Commons was to correct the problems of his initial 1723 system that relied on ventilating fires. He claimed that, to some extent, the failure of his first system was a result of poor cooperation from the housekeeping staff. "Mrs. Smith the Housekeeper, who had possession of the Rooms over the House of Commons, not liking to be disturbed in her use of those Rooms, did what she could to defeat the Operation of these Machines; which she at last compass'd [*sic*] by not having the Fire lighted."[12] It is claimed he invented the term *ventilator* "to describe the man who turned the crank of the centrifugal fan he was proposing."[13]

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

The House of Commons, c.1710
(From "The Palace of Westminster," Sir Robert Cooke, 1987)

By 1707, a fresh problem was presented as the result of the Act of Union between England and Scotland. There were forty-five extra Scottish Members. Wren believed that by creating two rows of seats in each of the side galleries, where but one existed, and at a cost of £270, the problem might be solved. Although these changes provided the necessary accommodation, the subject of ventilation was by 1701 concerning a committee, assisted by Wren, and they considered methods of improvement. They tried openings in the ceiling through which they hoped the exhausted air would escape into the space above. This was not a complete success. In 1715 the Speaker invited a Fellow of the Royal Society, Dr. J.T. Desaguliers, an experimental physicist, to "propose a method to evaporate the unhealthful breathing in the House of Commons." Wren had constructed four square apertures, one at each corner of the ceiling. These gave into truncated pyramids in the room above. When the lids on the top of the pyramids were opened the foul air from below and the steam of the candles should have found its way into the room above. However, the air above being colder and denser, all that was achieved was a down-draught on to "those Members that sate under those Holes." Dr. Desaguliers constructed a pair of closets, one at each end of the room above. An iron duct from the top of each of the pyramids led to a jacket round a fire-grate in each of the closets. It was intended that the fire should be lit at noon, thus drawing up the air from the House below. Needless to say, Mrs. Smith, the Housekeeper, who had the use of rooms above the Commons, found the new apparatus a nuisance and did her best to defeat the operation of these machines. She neglected to light the fire at the appointed hour. The House got intolerably hot, and the cold air above resisted its escape, making conditions even more intolerable. Mrs. Smith was in due course called to order. Provided that she carried out her instructions to the letter, the House was kept cool. Desaguliers received a reward of one hundred guineas for his invention. Forty-six years later, Members were complaining of the great inconvenience from the heat of the House of Commons when it was full and from the cold when it was thin. The Office of Works installed new stoves below the House and larger vents were formed in the ceiling and a new louvre, with moveable shutters, was inserted in the roof. This became a prominent Westminster landmark. A year later, loose masonry at the north-east corner turret fell through the roof of the Speaker's withdrawing room below. In 1791 a committee of the House was set up to look again at the problem of heating and ventilation. Henry Holland's new ventilators in the roof, a patent air machine and "two new large pieces of foliage" (to conceal the vents) sufficed for a while.

(From Chapter 8 "Smells, Bells and the Great Ventilators," of "The Great Palace," Christopher Jones, 1983)



46. *Fanning Wheel of Dr Desaguliers, 1735. Used in the House of Commons, where the term ventilator was used to describe the man employed to turn the crank handle which operated the fan. Philosophical Transactions (abridged), VIII, 1735, plate II.*

(From "The Quest for Comfort," Brian Roberts, CIBSE. 1997)

ON THE

HISTORY AND ART

OF

WARMING AND VENTILATING

ROOMS AND BUILDINGS

BY

OPEN FIRES, HYPOCAUSTS, GERMAN, DUTCH, RUSSIAN, AND
SWEDISH STOVES, STEAM, HOT WATER,
HEATED AIR, HEAT OF ANIMALS, AND OTHER METHODS;

WITH

NOTICES OF THE PROGRESS

OF

PERSONAL AND FIRESIDE COMFORT,

AND OF THE

MANAGEMENT OF FUEL.

ILLUSTRATED BY TWO HUNDRED AND FORTY FIGURES
OF APPARATUS.

BY

WALTER BERNAN,

CIVIL ENGINEER.

[illegible], Robert

VOL. II.

LONDON:
GEORGE BELL, FLEET STREET.
MDCCCXLV.

(From Google Books)

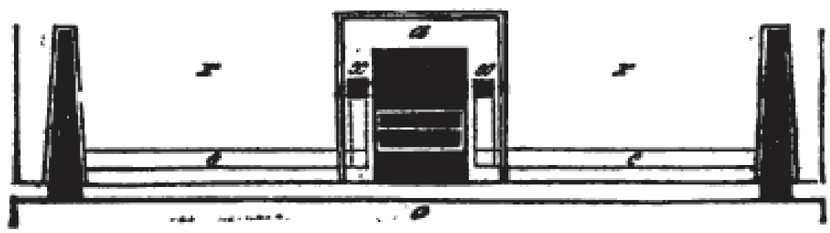
In English houses there seems to have been no other ventilating process except to open a door or a window, or a hole in the wall, or ceiling;* and it was in this way that Sir Christopher Wren attempted to ventilate the House of Commons. At each corner of the house, in the ceiling, he made a large square hole, which was the bottom of a truncated pyramid, that was carried 6 or 8 feet into the room over the house, and could be opened or shut perhaps with a sort of lid. Through these holes the breath of the people below, and the steam of the candles, issued into the room in which the pyramids were placed. But it often happened, that when the pyramidal funnels were opened, the air above, being colder and denser than what was in the house, descended through the pyramids and annoyed the persons that sat beneath them.

Dr. Desaguliers, who was called upon in 1723 to remedy the inconvenience, discharged his commission with great ingenuity, and so as to retain the pyramids and the roof in the state they were left by Sir Christopher.

He built two closets, one at each end of the upper room, between the pyramids, and leading a trunk from the pyramids to the square cavities of iron that went round a fire-grate fixed in the closets, as soon as a fire was lighted in the grates the air came up from the house through the heated cavities into the closets, and so went away up their chimneys.*

Fig. LXIV. will give a notion of this arrangement; *c c* are two of the pyramids, *e e* two pipes leading

FIG. LXIV.



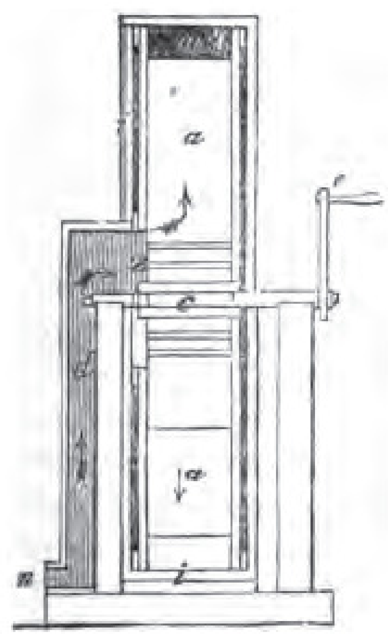
from them to the fire-grate, and *o* its chimney. The heat of the fire rarefying the air in the iron cavities, *x x*, a current was produced in *e* and *e*, and the air from the pyramids flowed at *x* into the closet, *r*, and thence into the chimney, *b*.

In 1727 the doctor designed a machine for the Earl of Westmoreland, to clean a mine of foul air, whether of greater or less specific gravity than the atmosphere. It consisted of a triple iron crank, a foot long, working three copper-barrelled pumps, of 18 inches internal diameter, which by means of three regulators were alternately applied, to force air into a place, and extract it through trunks or pipes that were 10 inches square in the inside. The engine worked with a great deal of ease, and there being little atmospheric pressure or weight to be removed, and only the resistance from friction in giving a moderate velocity to the air in the pumps, one man was able to discharge 10 cubic feet in a minute.

Seven years afterwards he exhibited to the Royal Society a model of a machine for "changing the air of the room of sick people in a little time, either by drawing out the foul air or forcing in fresh air, or doing both successively, without opening doors or windows," which he thought would be of great use in all hospitals and prisons, and also serve to convey air into a distant room, "nay, to perfume it occasionally."

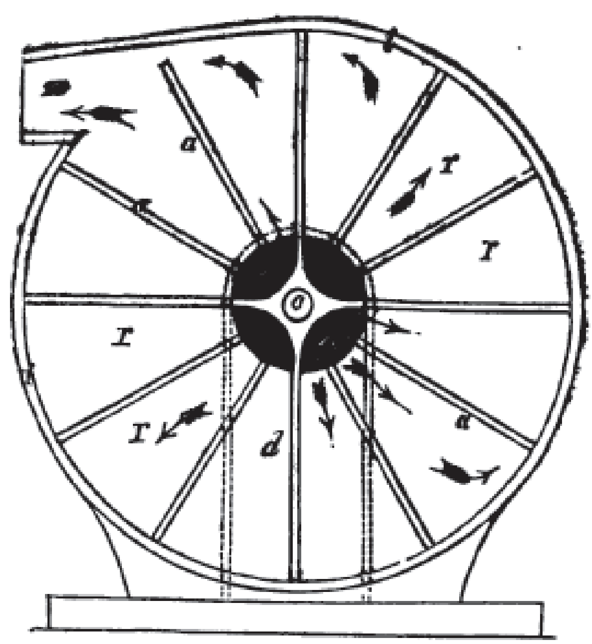
The wheel shown in Fig. LXV. and Fig. LXVI., is described to be 7 feet in diameter and 1 foot wide.

FIG. LXV.



The 12 radiating partitions, *a a*, approached to within 9 inches of the axis, leaving a circular opening, *z*, 18 inches in diameter. The wheel was enclosed in a concentric case, *i*, which had a "blowing pipe," *m*, on the upper part of its circumference, and a suction pipe, *n*, that communicated by a funnel, *d*, with the central open-

FIG. LXVI.



ing, *z*, in the wheel, which was turned by a handle, *e*, attached to the axis, *c*, that went through the case and rested on a standard. The "fanner" was adjusted to revolve easily, but as closely to its concentric casing, *i*, as possible, and it had no communication with the air except through the suction and blowing pipes. By the revolution of the wheel, the air entering through the central opening into the spaces, *r r*, formed by the radiating partitions, was thrown by the centrifugal motion towards the circumference, where it was confined by the concentric casing, and carried round until it arrived at the opening of the blowing pipe, *m*, into which it was impelled by each radiating partition in continuous revolution. When the suction pipe, *n*, was open to the atmosphere, or to a space containing heated air, and the blowing pipe connected with a room, the apartment was filled with cold, or with heated air, in any desired quantity, by increasing or diminishing the speed of the wheel. If foul air had to be drawn out, the suction pipe was connected with the room, and the blowing pipe with the atmosphere; and when it was not required either to draw out foul or introduce fresh air, but to keep the *air of the room in motion* only, the suction and blowing pipe both opened into the apartment.

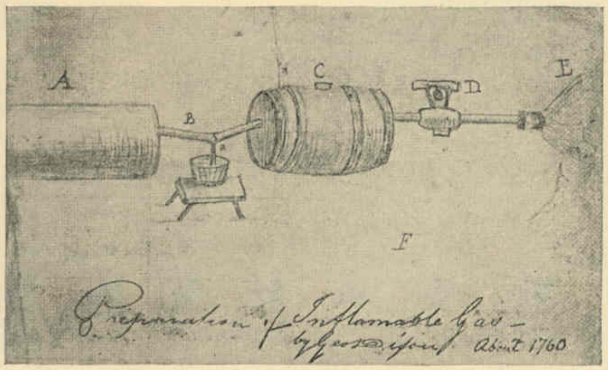
The thermo-ventilator at the House of Commons became an object of hostility to an individual whose feelings and "perquisites" had been hurt by its erection. Mrs. Smith, the housekeeper, not liking to be disturbed in her possession of the rooms of which she had the use, did what she could to defeat the operation of the ventilating closets; and her perseverance and "science" enabled her not only to baffle the good-natured philosopher, but to stand clear from the reproof of the "House" itself, that she diurnally stifled. Mrs. Smith's system of tactics was formed on the negative principle, and "she carried her point by *not* having the fire lighted until the House had sat for some time, and was very hot; for then the air in the closets descended into a rarer air, and it became hotter instead of cooler. But when the fire was lighted, before the meeting of the members, the air ascended into the closets and out of their chimneys, and continued to do so the whole day, keeping the house very cool." *

Sir George Beaumont, and some other members "observing, that the design of cooling the house was frustrated, in 1736, asked me, said the doctor, if I could not find some contrivance to draw the hot and foul air out of the House by means of some person that should entirely depend upon me; which I promised to do, and effected, calling the wheel a centrifugal or blowing wheel, and the man that turned it a ventilator. This wheel, in some things like Papin's Hessian bellows, differs much from it; being more effectual, and able to suck out the foul air or throw in fresh, or to do both at once, according as the Speaker is pleased to command it, whose order the ventilator waits to receive every day of the sessions."

GEORGE DIXON
1810-1882

Gas Experimenter

* About 1760, Mr. George Dixon, of Cockfield, Co. Durham, experimented with coal gas as an illuminant. John Bailey, of Chillingham, in 1810 published his "General View of the Agriculture of the County of Durham," in which he referred to the making of coal tar. Bailey states that the first works in the county for extracting tar from coals were established at Cockfield in 1779, "by the original inventor, the late very ingenious Mr. George Dixon." Bailey gives the following account of Dixon's experiments on the use of coal gas as an illuminant: "He had discovered the process for extracting tar from coal upwards of twenty years before he began to manufacture it for sale, as I remember being much amused when a little boy,



Sketch of George Dixon's Apparatus.

George Dixon apparatus for distilling coal, the portion marked "E" on the right being, apparently, a bladder for collecting the gas.

by his filling an old tea-kettle half full of coals, setting it in the fire, and luting a tobacco pipe with clay to the spout, and to this several others round the end and side of the room; after a certain time he put the flame of a candle to the end of the farthest pipe and immediately a bright flame issued from it, where nothing was perceptible before; he then made small holes with a pin through the clay that luted the pipe heads and shanks together, and applying the flame of a candle to each, there were as many flames as pipe heads. He had only made the discovery a little before this, and this was probably the third or fourth exhibition of illuminating rooms by gaslight."

From "A History of Gas Lighting" (CIBSE Heritage Group Collection)

Sir HENRY DOULTON
1820-1897

Company Founder

HENRY DOULTON was one of eight children born to John Doulton (1793–1873), who had joined a pottery in Vauxhall Walk, Lambeth in 1815. Henry joined his father's business in 1835, which was then trading as Doulton and Watts and located in Lambeth High Street. The company manufactured salt-glazed stoneware vessels, chiefly bottles for blacking, ink and beer. The younger Doulton rapidly acquired the skills of the potter and was soon playing a leading role in the running of the business. He introduced steam power for driving the throwing wheels, and by the late 1830s had begun manufacturing architectural terracotta and garden ornaments. To celebrate his coming of age, he produced a 300-gallon jar by hand, described as the largest stoneware vessel in the world.

It was the opening of new works in Lambeth to manufacture salt-glazed stoneware sewer pipes in 1845 which was to transform the fortunes of the company and establish Henry Doulton's reputation. Edwin Chadwick, the leading sanitary reformer along with Doulton's friends, the engineering inspectors, Edward Cressy and Robert Rawlinson, convinced him that the stoneware pipe would form the basis of a sanitary revolution. The success of the new factory in Lambeth and the increasing demand for sanitary pipes led to the opening of additional factories at St Helen's in 1847 and Dudley in 1848. By 1854, it was estimated that Doulton was responsible for a fifth of the sewer pipes produced in Great Britain. In 1854 John Watts retired and the company became known as Doulton and Co. Doulton manufactured his first ceramic sink in 1859, and by the 1860s was making stoneware closet pans. In 1877 Doulton entered a partnership with the old established firm of Pinder, Bourne and Co., at the Nile Street Pottery, Burslem, Stoke-on-Trent. They were important makers of tableware and earthenware sanitaryware. In 1882 Doulton gained complete control of the company and was able to consolidate his presence in the Potteries. In 1888 works were established in Paisley – primarily to manufacture cast-iron baths and cisterns – and production of fireclay goods at Dudley began in 1897.

Sir Henry Doulton. (*National Portrait Gallery*)

By the 1890s Doulton and Co. were established as one of the leading sanitaryware manufacturers in Britain, but the company had, meanwhile, diversified into many other areas of ceramic manufacture, including art pottery and various types of tableware, including bone china. From the 1870s the company had been celebrated for its Lambeth 'faience', and in health exhibitions of the 1880s Doulton's stands often contained entire bathroom schemes featuring their own sanitary fittings and faience tilework. Doulton also staged impressive displays overseas, including the Philadelphia Centennial Exhibition of 1876 and the Chicago International Exhibition of 1893. Doulton was presented with the Albert Medal by the Royal Society of Arts in 1885 and knighted by Queen Victoria in 1887. The company continued to thrive after his death in 1897, and after a tortuous history of mergers in the twentieth century remains an important name in the field of bathroom ceramics.

From Bogs, Baths & Basins," David J Eveleigh, 2002 (CIBSE Heritage Group Collection)

The "Unitas" All-Ceramic Wash Down Closet, 1883

Doulton's Improved Hooded Baths, Lambeth, London, c.1890