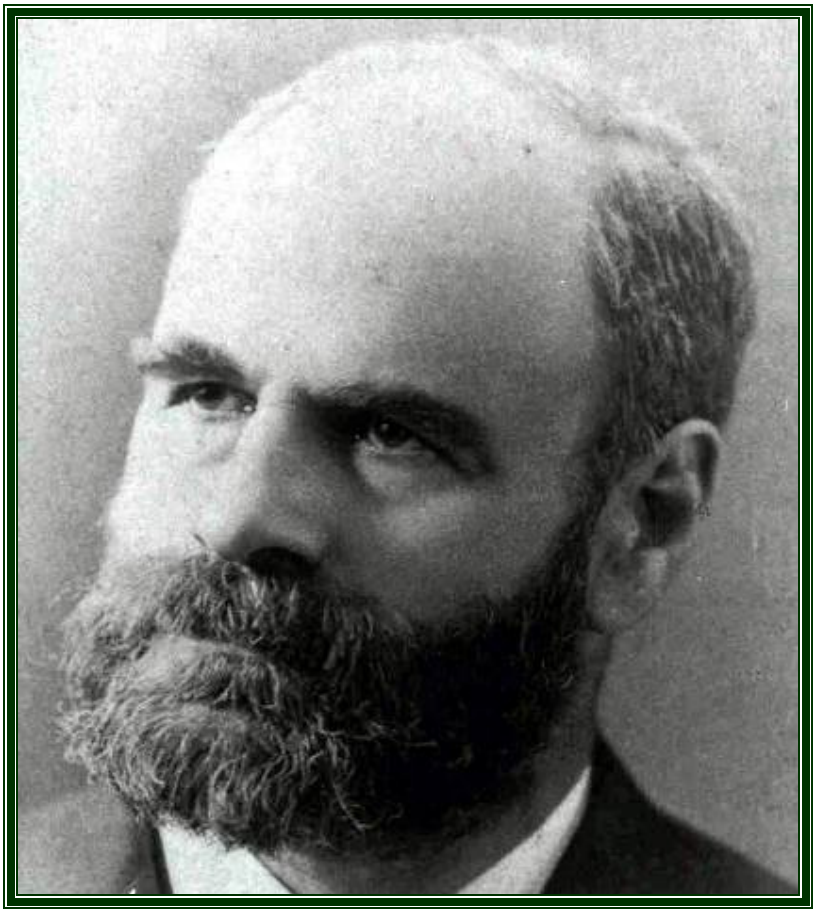
DANKMAR ADLER
1844-1900

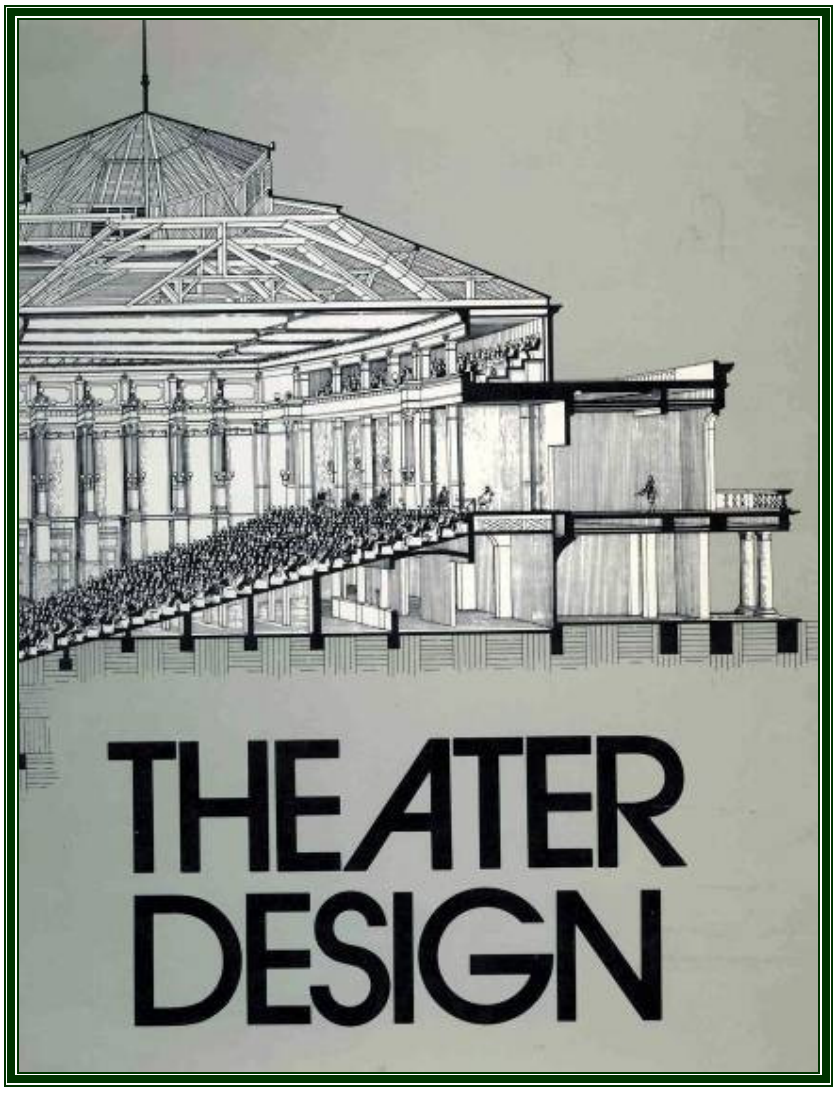


Structural and Acoustic Engineer

[198] Dankmar ADLER **1844-1900**

Engineer. Partner of Sullivan [199] in Chicago and between them successfully designed many theatres, most notable being that in the Auditorium Building, Chicago (1889). The Auditorium Theatre has been described as "a happy marriage of science and art" and with a capacity of 4237, was among the largest ever erected. Adler's engineering talents included a thorough knowledge of acoustics. The rake of the stalls and the rise of the balconies were designed on a principle called the "isocoustic curve," while "the shape of the ceiling was determined almost entirely by acoustic considerations.... Adler's calculations involved absorption, reflection, and reverberation...the result was miraculously successful. The arches, also, besides carrying Sullivan's decorative lights, are used for the ventilation equipment, the air ducts being disguised as ornaments."

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

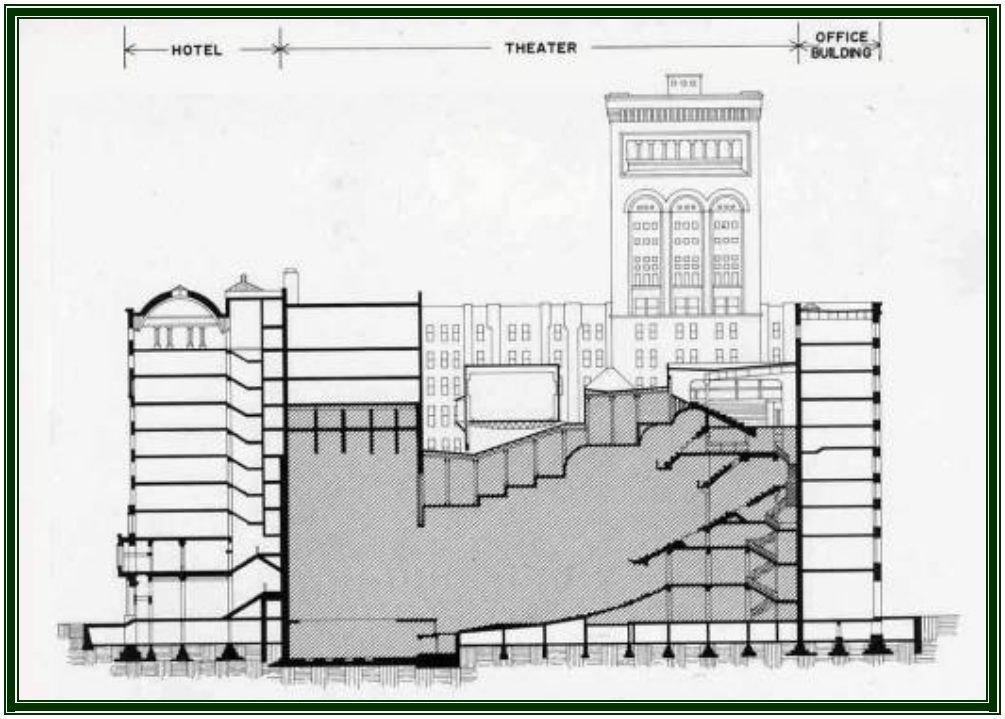


("Theatre Design," George G Izenour 1977: CIBSE Heritage Group Collection),

Dankmar Adler (1844–1900), an architect, engineer, and senior partner in practice with the illustrious Louis Sullivan, has not gained in either architectural or theatrical history the recognition he rightly deserves for his part in the design of the most important and influential theater building of the nineteenth century after Bayreuth Festspielhaus: the Auditorium-Theater in Chicago (Figs. 2.94–2.100). Adler, the older and more retiring of the two partners, was born in Stadt Lengsfeld, Germany, the son of a rabbi. He came to the United States in 1854, was educated in the public schools of Detroit and Ann Arbor, Michigan, served as an engineering officer in the Union Army during the Civil War, and thereafter settled in Chicago to practice architecture; there he participated as architect and engineer in the Chicago building boom that followed the disastrous fire of 1880. He combined forces with Sullivan as design partner in the firm of Adler & Sullivan, in which Adler was the chief engineer and business organizer.

After sifting the evidence there is, in my judgment, no question that the plan, room shaping, innovative flying balconies, articulated hinged ceilings and sight lines (based on Adler's modification of John Scott Russell's isacoustic curve; see sec. 2.6 and App. 3) resulting in the striking and innovative section of the Auditorium-Theater (see Figs. 3.109–3.114), are Adler's. Sullivan's exterior design (Fig. 3.108) and interior decorative ornament (Figs. 2.99 and 2.100), itself innovative and original, is not theater design. Adler, assisted by Paul Mueller (his young structural engineering associate) used oak cribbed spread footings in the sandy lakefront subsoil, where he was hampered by tricky groundwater conditions (the foundations were below the level of Lake Michigan). He ran the risk of major disaster at a time when cast-iron columns and wrought-iron beams and trusses were just coming into general use and the heavy masonry exterior bearing wall was still accepted practice.

Text extract and Pictures from "Izenour"



Auditorium Theatre, Chicago

F PAUL ANDERSON
1867-1934

Member ASHRAE Hall of Fame

[179] F. Paul ANDERSON **1867-1934**

ASHVE Laboratory Director (1921-1925). During his tenure, some 62 scientific papers were published. Most notable the *Comfort Zone Chart* (1924), "superimposed upon the Effective Air Chart and can be used to determine the relative comfort of ordinary indoor conditions from the dry- and wet-bulb temperatures of the air." ASHVE President (1927). Later, Dean of Engineering at Kentucky State University until his death. The F. Paul Anderson Award (established 1930) is awarded annually by ASHRAE for notable scientific achievement relating to HVAC&R. Anderson was one of the first members inducted into the ASHRAE Hall of Fame.

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

F. Paul Anderson served as dean of engineering at what is now the University of Kentucky for 43 years until his death in 1934. He is also a past-president of ASHVE. From 1921-25, Anderson was director of the ASHVE research laboratory, where fundamental research in heat transfer and indoor environmental conditions was conducted. Under his leadership, the comfort zone of atmosphere was established. In 1930-31, ASHVE acknowledged Anderson's leadership in research and in directing the education of many heating and ventilating engineers by establishing the F. Paul Anderson Award.

(From "HVACR Industry Pioneers Inducted into ASHRAE Hall of Fame,"

ASHRAE Journal, September 1994)

1927

ASHVE

F. PAUL ANDERSON

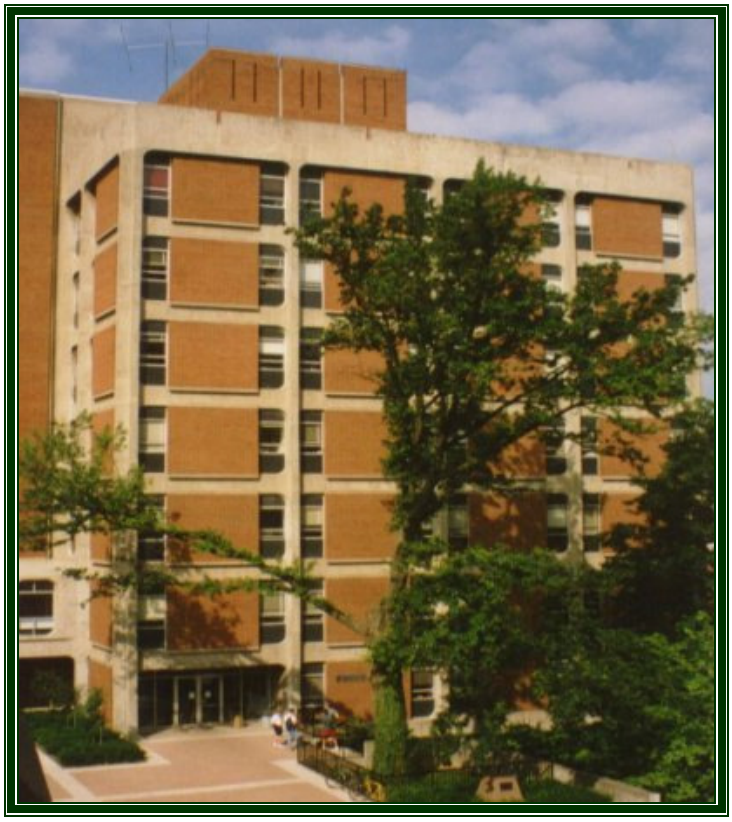
1867-1934

LEXINGTON, KY

"Isn't it...a fitting thing for this Society, although we may be interested...in one of the narrower fields of human interest, to be the sponsor for [Benjamin Franklin] who represents the ideals that are at the very basis of this government?" (p. 210, Mar. 1928, *ASHVE Journal*)

(From "Proclaiming the Truth," ASHRAE, 1995)

In 1927 Benjamin Franklin was declared the Patron Saint of ASHVE



F Paul Anderson Tower, University of Kentucky

F PAUL ANDERSON **1867 – 1934**

Anderson graduated from Purdue University in 1890 and received a Professional Mechanical Engineer degree in 1894. In 1891, he was appointed Professor and Dean of the School of Mechanical Engineering at A&M College of Kentucky, located in Lexington. He was a scholar as well as a noted engineer. He devoted his life to building a notable College of Engineering, and under his leadership, it became one of the top schools in the nation. In 1921, Professor Anderson was appointed Director of Research of the ASHVE in Pittsburgh. He recruited many of his best students and faculty members to work at the laboratory and during his tenure 62 scientific papers on heating, ventilating and air conditioning were published. The most important studies were those directed toward developing a comfort zone of atmosphere. In 1927, Professor Anderson was elected President of ASHVE as a result of his contributions to the Society. When ASHVE initiated an award in 1930 for the person who had made the greatest contribution to the field of heating and ventilation, the award was named after him. F Paul Anderson was inducted into the ASHRAE Hall of Fame in 1994.

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

JOHN GEORGE APPOLD
1800-1865

Devised an apparatus for regulating the temperature and moisture content of air within a building and also invented a successful centrifugal pump

[127] John George APPOLD **c. 1851**

English inventor. His apparatus for regulating temperature and keeping the air in a building at any desired degree of moisture is described in the Proceedings of the Royal Society of London (1866-1867) and explained by Billings [73]: "This instrument consists of a glass tube having bulbs at each end. The tube is filled, as also about half of each bulb, with mercury, the lower bulb, containing ether to the depth of half an inch, which floats on the mercury. The tube is secured to a plate of boxwood, and supported on knife edges, on which it turns freely. At the end of the plate, underneath the highest bulb, is a lever to which a string is attached. This string is carried by means of bell cranks to the supply valve of a gas stove or the damper of a furnace." (The evaporation/ liquefaction of the ether with temperature moved the balance assembly and controlled the string.)

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

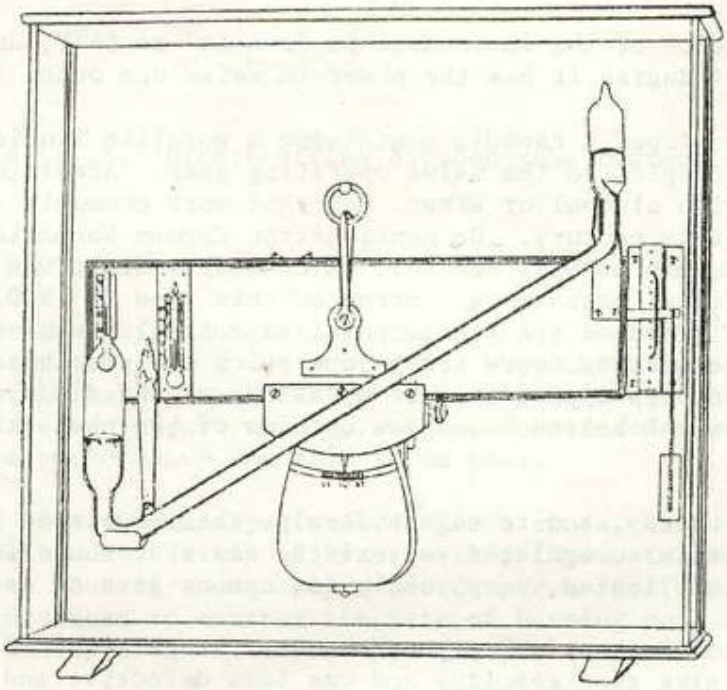


Fig. 11.4. Appold's apparatus for regulating temperature and keeping the air in a building at any desired degree of moisture (1866).

Appold's apparatus for regulating temperature and keeping the air in a building at any desired degree of moisture, is described in the *Proceedings of the Royal Society of London* (1866-67) (Fig. 11.4). The operation of Appold's apparatus is explained as follows:[4]

"This instrument consists of a glass tube having bulbs at each end. The tube is filled, as also about half of each bulb, with mercury, the lower bulb containing ether to the depth of half an inch, which floats on the mercury. The tube is secured to a plate of boxwood, and supported on knife edges, on which it turns freely. At the end of the plate, underneath the highest bulb, is a lever to which a string is attached. This string is carried by means of bell cranks to the supply valve of a gas stove or the damper of a furnace.

The instrument acts in the following manner:

Supposing the stove to be lighted and to have raised the temperature more than is required, the heat will convert a portion of the ether in the lower bulb into vapour. The expansion of this vapour drives a quantity of the mercury out of the bulb underneath it through the tube into the upper bulb. The end to which the mercury has been driven being thus rendered the heaviest, falls, and motion being communicated by the lever to the string, this closes the supply valve or damper of the stove or furnace. Of course, if this should be carried beyond the required extent, the reverse action will take place.

A weight in the centre of the plate, the position of which is regulated by a milled-head screw shown at the side, serves to alter the centre of gravity of the whole apparatus. The value of the motion of this weight being carefully ascertained, a scale is engraved upon it. By moving this weight, according to a scale engraved on it, the instrument may be set so as to maintain any desired temperature in the building in which it is fixed.

The range of action of the instrument is from 54° to 66°F, and with a change of temperature of 1 degree it has the power to raise one ounce 3 inches."

Meanwhile, on this side of the Atlantic, the centrifugal pump was also being developed independently by both Appold and Bessemer. Prior to the Great Exhibition of 1851 much controversy raged between Appold, Bessemer and Gwynne over the merits of their respective pumps (Fig. 8.9). The argument was conclusively settled by the tests conducted by the Jury of the Exhibition, which gave the following results:[7]

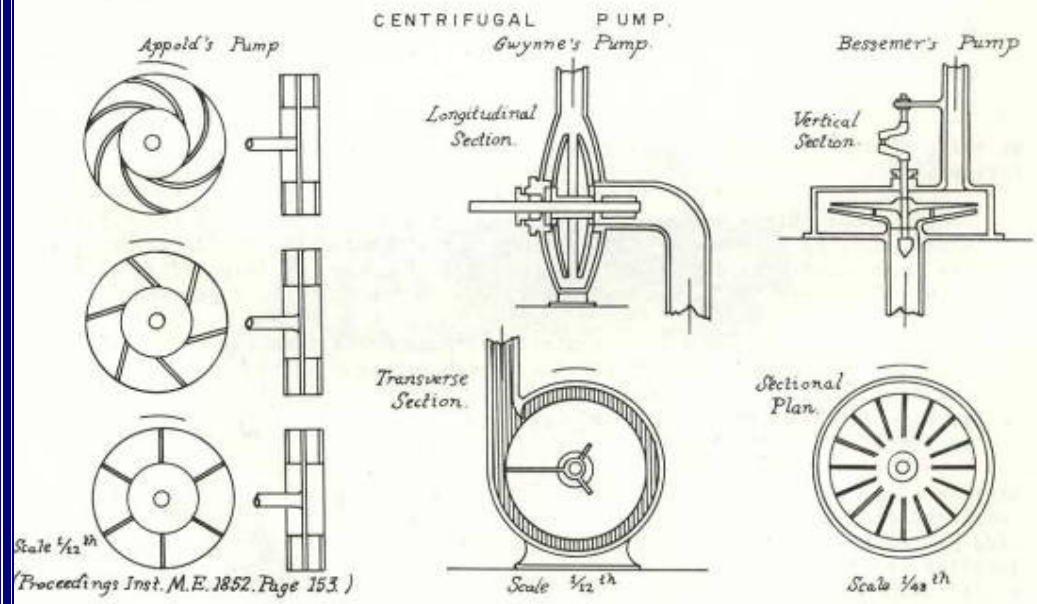


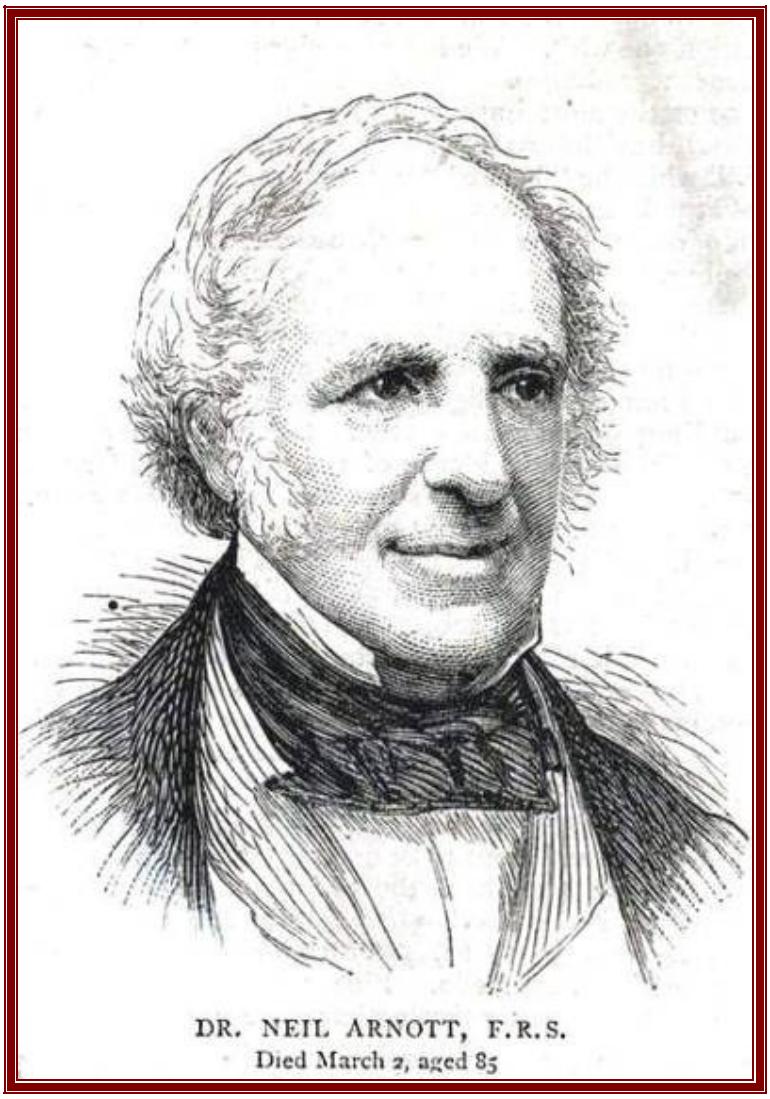
Fig. 8.9. The three pumps at the 1851 Exhibition (by Appold, Gwynne and Bessemer).

Make	Water quantity (l/s)	Head (m)	Speed (rev/min)	Efficiency (%)
Appold	94	5.9	788	68
Bessemer	64	1.0	60	22.5
Gwynne	22	4.2	670	19

Gwynne's pump was handicapped by its small size and having only one blade. Bessemer's model suffered due to its very slow speed and its radial bladed design. The superiority of the Appold pump is apparent, due to its high speed and the curved vanes on the impeller.

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

Dr NEIL ARNOTT FRS
1788-1874



Inventor of the "Thermometer Stove"
A detailed biography is available under **Victorian Heating Engineers**
elsewhere on this web site

[126] Neil ARNOTT **1788-1874**

Doctor of Medicine, FRS, and Physician Extraordinary to Queen Victoria. Lectured to the Royal Institution on his Thermometer Stove (1836). Went on to write the book, *On Warming and Ventilating with Directions for Making and Using the Thermometer-Stove, or Self-Regulating Fire, and Other New Apparatus* (1838). Arnott described the use of fires, chimneys, and stoves, explained heating by steam, hot water, and hot air, their application to various buildings, and how to make a thermometer-stove. He believed his stove would reduce England's consumption of coal by half, if controlled by one of his thermometer regulators. "In one design he used a long bimetallic strip, one end of which was fixed to the casing of the stove and the other was attached to the combustion air damper. Other regulators described by Arnott relied upon the expansion of air in a tube closed by mercury: a float on the mercury surface was linked to the damper. All these devices controlled the temperature inside the stove casing, not that of the room."

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

ventilation. In Arnott's *On Warming and Ventilating*, published in 1838, he states "that a man of sound constitution, and who remains uninjured by poisons or violence, may have uninterrupted health for the full period of human life, there are only four things or conditions which he can ever be required to provide or secure; namely air, warmth, aliment, and exercise of his bodily and mental faculties."[20]

Arnott's thermometer stove automatically regulated the fire by a damper that was controlled by pressurized air heated by the fire itself. Arnott's stove was regulated by a steel/brass compound metal bar, or "pyrostat," that roughly doubled the volume of air for a 480°F temperature rise (Figures 4-24 and 4-25).

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

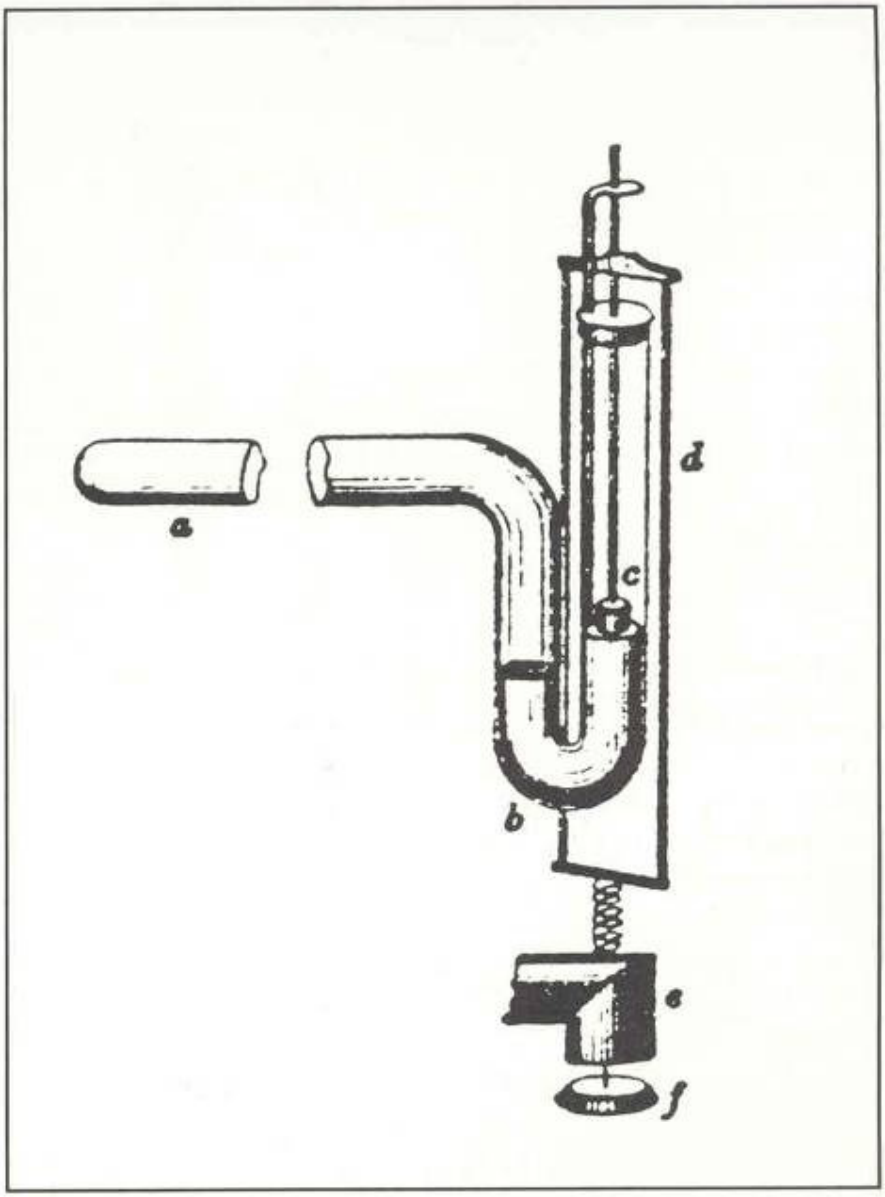


Figure 10-8 *Arnott's thermostat, 1836 (from Edward H. Knight, 1876,* Knight's American Mechanical Dictionary, *vol. III, Hurd & Houghton, New York).*

ON

WARMING AND VENTILATING;

WITH

DIRECTIONS FOR MAKING AND USING

THE

THERMOMETER-STOVE,

OR

SELF-REGULATING FIRE,

AND

OTHER NEW APPARATUS.

By NEIL ARNOTT, M.D., F.R.S., &c.

PHYSICIAN EXTRAORDINARY TO THE QUEEN,

Author of the "Elements of Physics," &c.

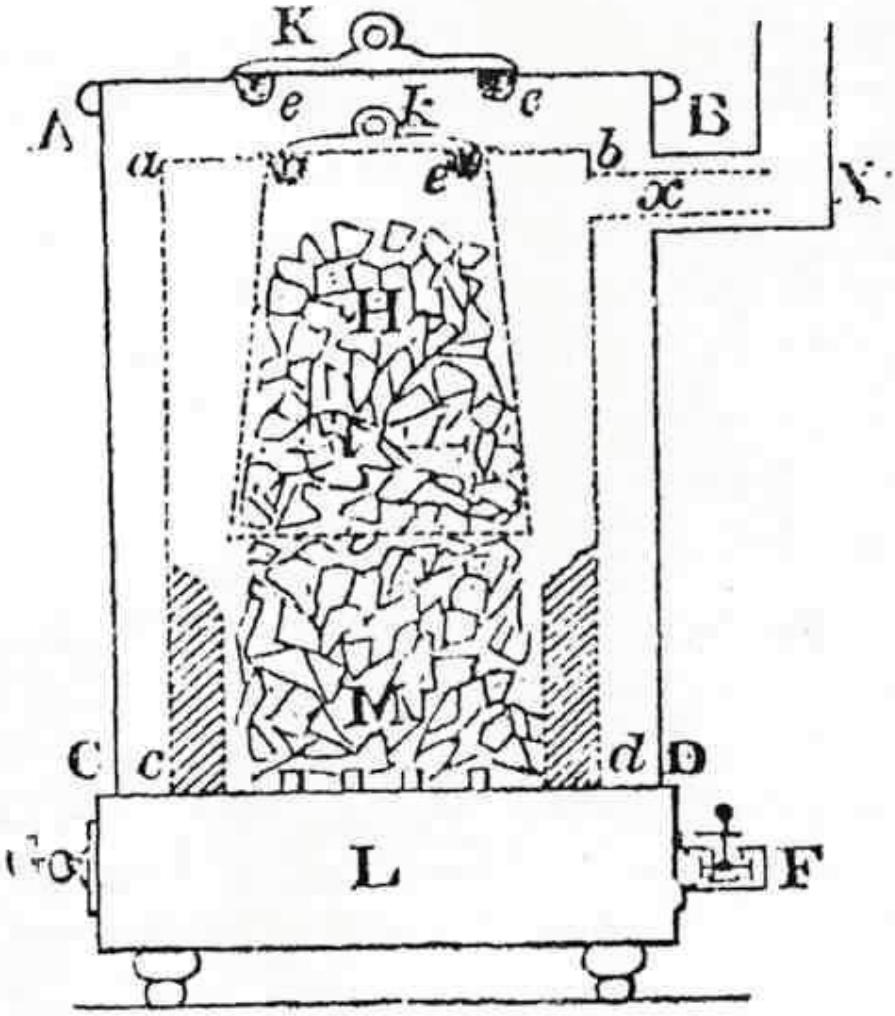
LONDON:

LONGMAN, ORME, BROWN, GREEN, AND LONGMANS,

PATERNOSTER ROW.

1838.

Arnott's Book of 1838 (CIBSE Heritage Group Collection)



ARNOTT'S SELF-REGULATING STOVE, 1834.

Neil Arnott, who was both a physician and a natural philosopher, was born in Arbroath, Scotland, of Catholic parentage. Misfortune eventually compelled the Father to give up a valuable farm and to move his family to Blair. The Arnott family finally settled in Aberdeen, where Neil was educated at the parish school of Lunan and also by his Mother.

At the age of ten, he entered the Aberdeen Grammar School and three years later, the Marischal College, with the aid of a small bursary. It was here that he first became interested in natural philosophy through lectures given by Patrick Copland.

In 1805, at the age of seventeen, he graduated as M.A. and, by partly supporting himself as shop assistant to a chemist, was able to begin his study of medicine. A year later, he left Aberdeen to study under Sir Everard Home, as a student at St. George's Hospital, in London.

Through Sir Everard Home's favour, he was appointed surgeon in the service of the East India Company, and, in April 1807, sailed for China. During a long and stormy voyage he appears to have made a number of physical and meteorological observations. Many of these are recorded in his "Elements of Physics" which appeared several years later. He learned several languages and gave lectures to the captain and his officers. His attention was also turned to sanitation, clothing and ventilation on the ship.

It was during his second voyage from England in 1810, that he performed a novel operation for stricture, which saved the life of the captain. Arnott was particularly concerned by the appalling loss of life due to the lack of ventilation in the ships of that time, and it was this that prompted him to establish new methods of ventilating in the ship on which he made his final return to England.

On his return to London in 1811, Arnott set up practice in Hunter Street, in partnership with his friend, Darling. Soon afterwards, he began a series of lectures on Natural Science

"The Life and Work of Neil Arnott," J R White, National College Thesis, 1958
(CIBSE Heritage Group collection)

applied to Medicine, at the Philomathic Institution. These lectures were published in 1827 and were entitled "Elements of Physics". In 1813, he obtained the diploma of the College of Surgeons and, in the following year, the University of Aberdeen confirmed upon him the degree of M.D. His knowledge of languages and his Catholic connections helped him in his profession and many people from foreign countries consulted him. He became physician to the French Embassy in 1816 and some time afterwards, physician to the Spanish Embassy. In the same year he dissolved his partnership with Darling, who had married, and soon afterwards took up residence at 38, Bedford Square, where he was to remain until the end of his professional life.

In 1823, Arnott began to prepare his "Physics". At about this time, Sir David Barry was giving lectures on the theory that the circulation of blood through the human body was due to atmospheric pressure. A Dr. Armstrong opposed this theory and persuaded Arnott to help him disprove it. This led to serveral lectures given in Arnott's house in 1825, on medical physics. At the time a Professor Bain wrote, "the lectures made a great impression and there was a stong desire expressed that he should repeat them".

The first volume of Arnott's "Physics" appeared in 1827 and was enthusiastically received. Between 1827 and 1833, several new editions were printed, together with the first and second editions of part one of the second volume. Arnott's "Physics" met with great success and was quickly translated into Spanish, French, Dutch and German. The book went out of print and Arnott spent much time on a sixth edition of the first volume, half of which appeared in 1864. The second half with new chapters appeared in 1865 and a seventh edition was published posthumously.

Arnott gave up his practice in 1855 and married in the following year.

In his retirement, Arnott directed his attention almost entirely to sanitation and scientific matters. Many years earlier, he had become well known through his invention of a smokeless grate, the main purpose of which was to combine fuel economy and smoke consumption with uniformity of combustion. He was awarded the Rumford medal for this in 1854 by the Royal Society. In 1832 he devised the "water-bed", whose function was to provide comfort for those confined to the bed for long periods of time. In 1838, he published an important treatise on "Warming and Ventilating" in which he described various forms of self-regulating fires. This essay arroused the attention of many manufacturers who secured patents for various devices based on his ideas. Many errors in manufacture were made and this prompted Arnott to prepare a book which was published in 1855 and gave complete accounts of his devices and explanations of the basic principles involved. Arnott, however, declined to patent his inventions, since he wished that everyone should benefit from them freely.

In the same year, Arnott was awarded the gold medal by the jurors of the Paris Exhibition, for his various inventions, and Napoleon III invested him with the cross of the "Legion of Honour". He was one of the founders of the University of London in 1836, and an original member of the senate. In 1837, he was appointed one of the physicians extraordinary to the Queen and in the following year, was elected a fellow of the Royal Society. He was elected a member of the Medical Council in 1854. Towards the end of his life, Arnott published several smaller works including a "Survey of Human Progress" written in 1861, which reached a second edition in the following year. It was well received although criticised as representing a "narrow utilitarianism". In 1867, he wrote a small tract on arithmetic and finally, in 1870, a pamphlet on national education.

Arnott retained unimpaired faculties to a great age. Among his last inventions was a "chair-bed" for preventing sea-sickness. As a prominent member of the Royal Institution, he had a large circle of friends and lived in the society of the most progressive men of science in London.

Arnott's benefactions were widespread. In 1869, he gave two thousand pounds to the University of London and one thousand pounds to each of the universities of Edinburgh, Aberdeen, Glasgow, and St. Andrews. In 1865, Mrs. Arnott gave a thousand pounds to each of two Ladies' Colleges in London and, after her husband's death, carried out his wishes by leaving a thousand pounds to each of four Scottish Universities.

In 1859, Arnott caught a cold which brought on a gradually increasing deafness and which, to a great extent, restricted his social life. A fall two years later resulted in concussion of the brain which weakened his mind. He died on the 22nd of March, 1874, and was buried in Edinburgh.

Arnott was physically a very strong man and had always enjoyed perfectly sound health during his sixty years of activity in London. He had a great aptitude for languages and excelled in handicrafts, games, drawing and playing musical instruments. As an inventor, his first thought was for the comfort and living conditions of his fellow men. He was very sociable and kind and always full of philanthropic aims and objects.

There is a crayon drawing of Dr. Arnott by Mrs. W. Carpenter in the Royal Society, and a portrait by Partridge in the Marischal College, Aberdeen. A biographical memoir of Dr. Neil Arnott by Professor Bain, was read before the Aberdeen Philosophical Society in 1881, and an obituary notice may be found in the Proceedings of the Royal Society, volume XXV, 1877.

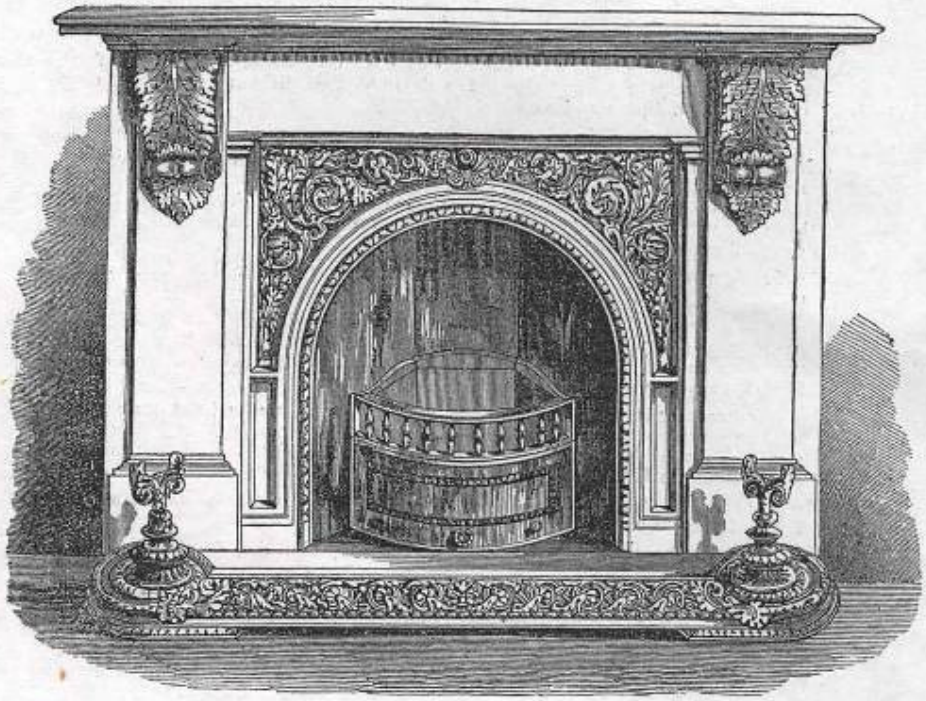
DR. ARNOTT'S

SMOKE-CONSUMING FIRE-GRATE,

MANUFACTURED BY

F. EDWARDS, SON, & CO.,

42, POLAND STREET, OXFORD STREET, LONDON.



NOTICE OF REPORT OF GENERAL BOARD OF HEALTH, LAID BEFORE PARLIAMENT.

"For Domestic Fires the admirable Fire-place recently invented by DR. ARNOTT, *and described at length in a recent number of the* Quarterly Review, *is probably, in the opinion of the Board, the improvement most likely to suit English habits and feelings. The principle of the Fire-place is that of supplying the fresh fuel at the bottom, instead of heaping it on the top of the fire. The coal is in a box nearly air-tight below the fire; the tar vapours and gases produced by the decomposition of the coal pass through the incandescent fuel above, and burn on reaching the air, while fresh fuel is supplied by pushing up the coal from below. The draft is regulated by a single valve, and the useless escape of heated air up the chimney diminished. The fire burns quite free from smoke, the burnt air is safely carried away, and fuel economized. The invention may be easily adapted to existing Fire-places.*—TIMES, June 25, 1855.

The importance of the subject of the consumption of smoke, both in a sanitary and economical point of view, has lately been fully demonstrated in the *Quarterly Review* for December, 1854, and the *Times* of January 2nd, 1855. In the invention of this grate, DR. ARNOTT has supplied the desideratum and introduced a principle of combustion, which it requires but little examination to convince, must give it very great advantages over the old form of grate, and the ordinary mode of burning fuel. A prospectus with full description of the principle and mode of action may be had on application.

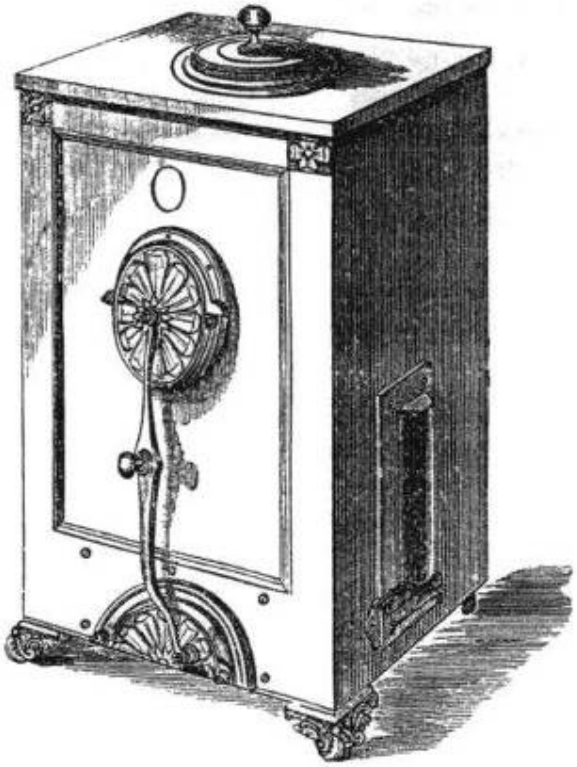
Advertisement for Arnott Fire-Grate, c.1855

COMYN CHING & CO., CASTLE STREET, LONDON, W.C.

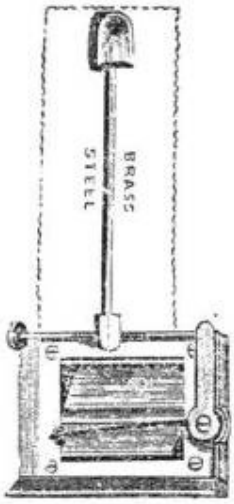
DR. ARNOTT'S
ORIGINAL SLOW COMBUSTION FUEL STOVES

WITH

Cook's Patent Regulator or Compound Bars.



Cook's Patent Regulator.



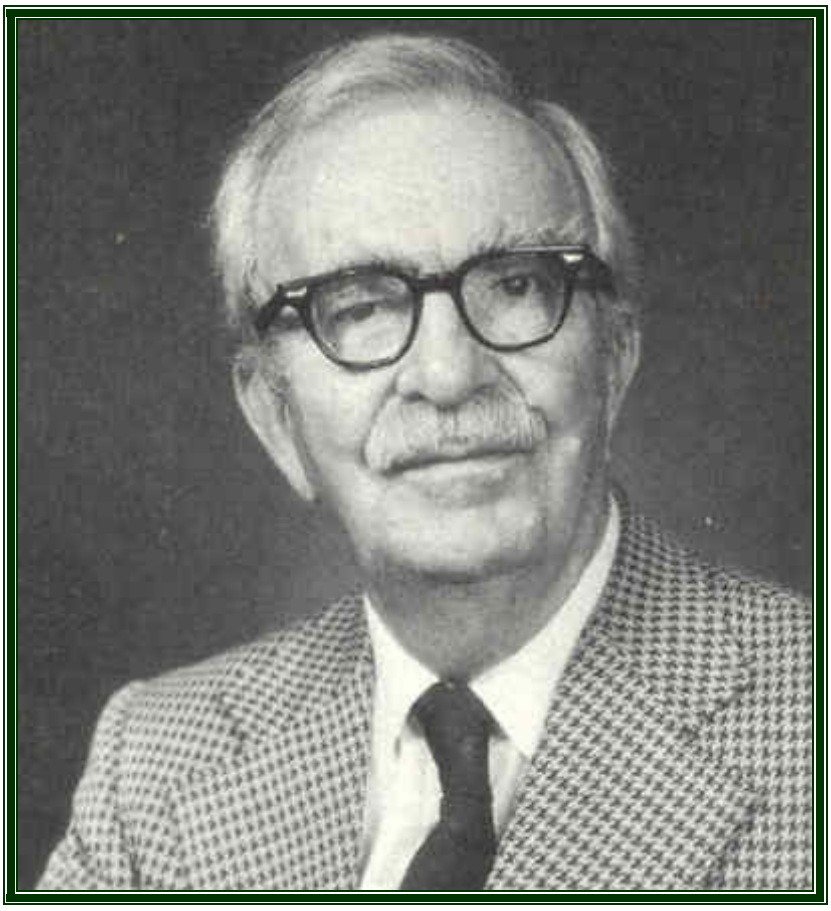
Many years since, this principle was perfected at our Works under the direct superintendence of Dr. ARNOTT, and though many new plans for economically and effectually heating apartments, churches, &c., have since been introduced, the continued and steady sale of these, prove, that they still compete successfully, with the many newer methods.

With these Stoves you reduce the supply of air to the smallest that can be, to support combustion; thus reducing to the minimum the amount of heat lost to use by escaping through the flue.

By Cook's Patent Compound Bar, you actually make your fire regulate itself, for as it begins to burn too fiercely, the Compound Bar becoming heated curves gradually and thus shuts off the supply of air.

Advertisement for Arnott's Slow Combustion Stove

CARLYLE MARTIN ASHLEY
1899-1993

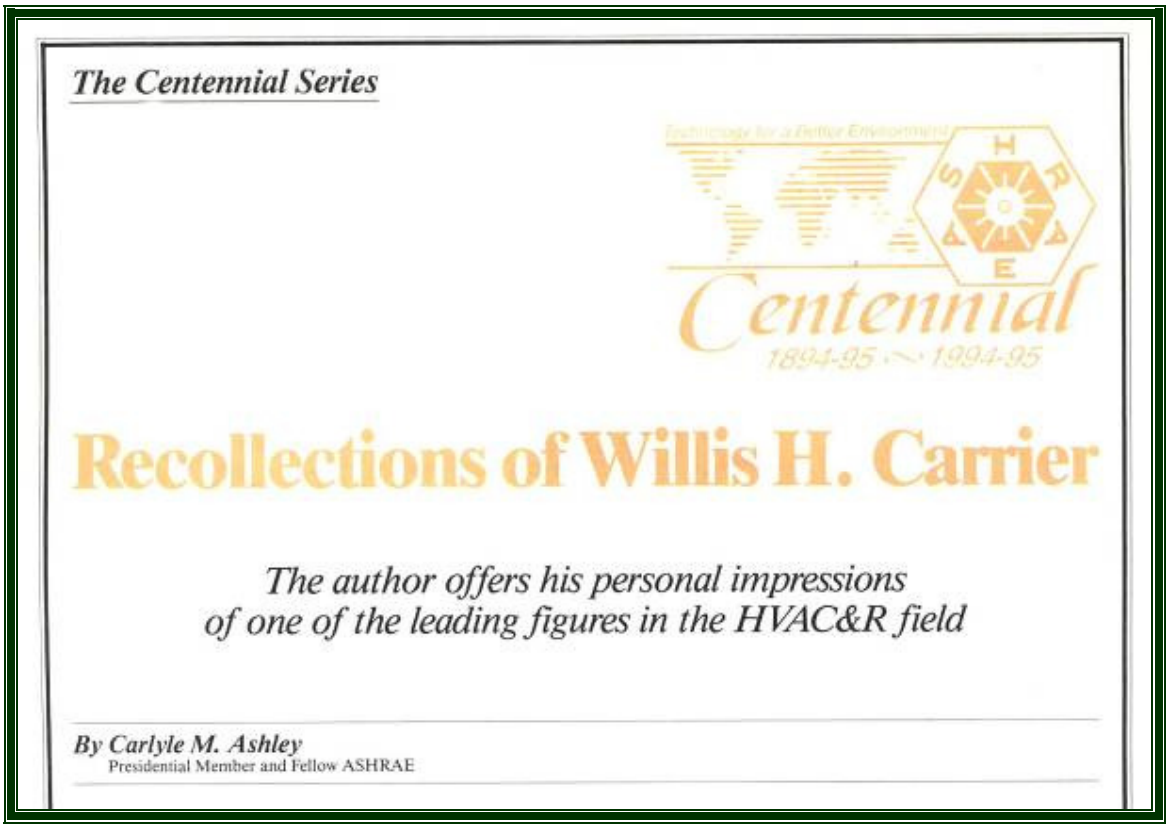


President ASRE 1956-57

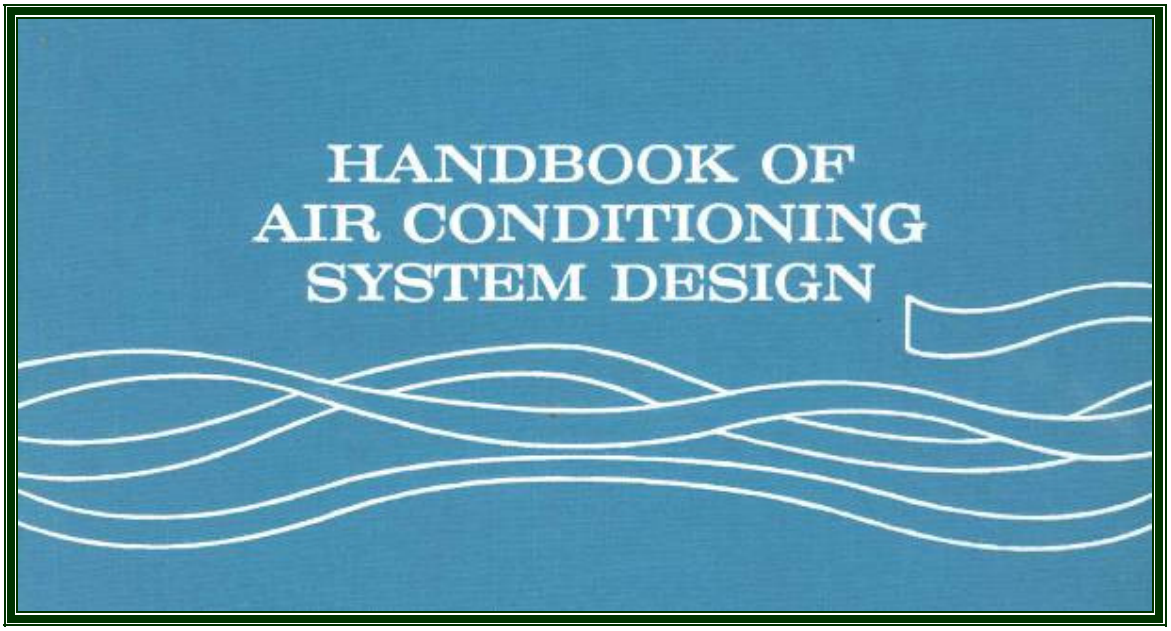
CARLYLE MARTIN ASHLEY **1899 – 1993**

Ashley received a degree in Mechanical Engineering from Cornell University in 1924. After graduation, he joined the Carrier Corporation and worked there until his retirement in 1967. He was recognized as an authority in both refrigeration and air conditioning engineering fields and was responsible for 63 patents. In addition, he authored 16 papers and 10 articles. Ashley served as President of ASRE in 1956-57. The ASHRAE-Alco Medal for Distinguished Public Service was conferred upon Mr. Ashley in 1971, and he received ASHRAE's Louise and Bill Holladay Distinguished Fellow Award in 1979. He had an active and distinguished career providing new developments and inventions which accelerated the advancement of air conditioning and refrigeration, Carlyle Martin Ashley was inducted into the ASHRAE Hall of Fame in 1995.

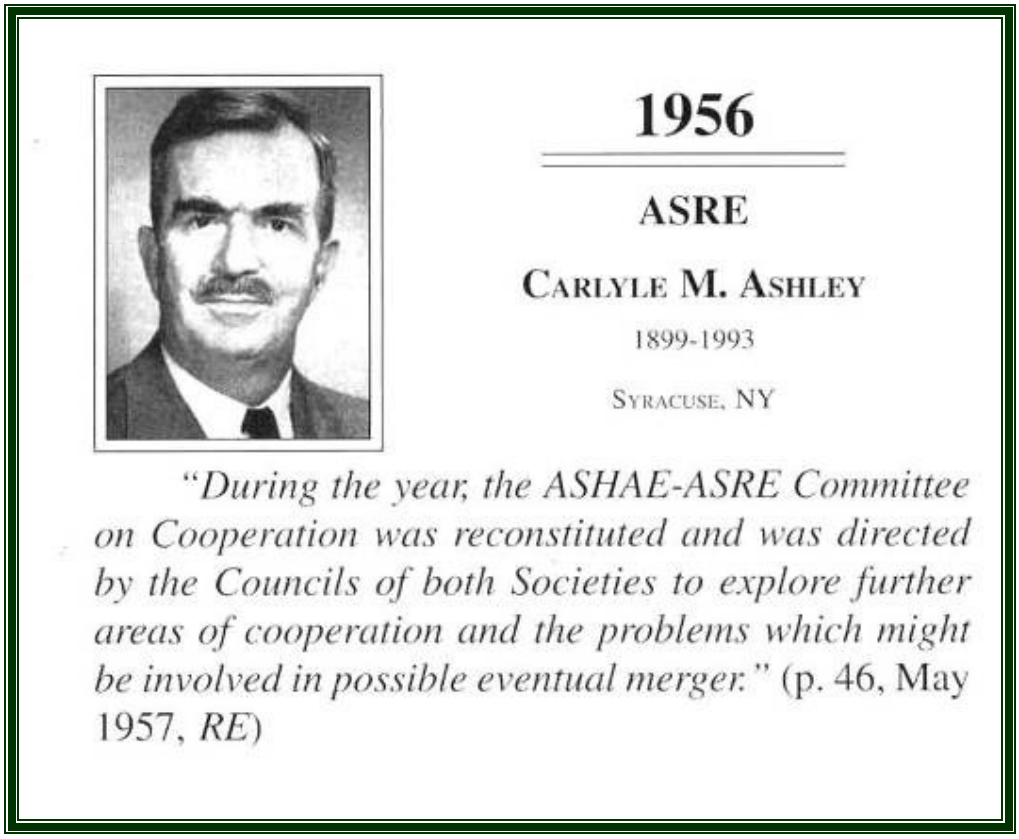
(Edited extract from ASHRAE "Hall of Fame" Citation)



ASHRAE Journal, October 1994



Title Block Carrier Handbook, 1965 (CIBSE Heritage Group Collection)



(From "Proclaiming The Truth," ASHRAE, 1995)