 

FREDERICK WITTENMEIER
Died 1928

No portrait has so far been discovered

[209] Frederick WITTENMEIER **died 1928**

German immigrant to USA. Originally a steam-fitter. Joined heating contractor and boiler manufacturer Kroeschell Bros., Chicago (1896). Convinced Kroeschell to enter ice-machine business. Claimed to have introduced CO_2 refrigeration into the USA, using the patents of Julius Sedlacek. Devised a direct-expansion system (1905) used with an air washing system, "first used dry coil surface cooling, later used sprays to wet coil surface for increased heat transfer." Kroeschell provided refrigeration for Pompeiian Room, Congress Hotel, Chicago (1906), for powder room on warship *USS Ohio* (1908), and for the Larkin Building, Buffalo (1909) for architect Frank Lloyd Wright [201]. Invented air cooler (USP 1,003,129: 1911). Installed cooling systems in Blackstone Hotel and Planters Hotel, both in Chicago, and in Rogers Hotel, Minneapolis. Wittenmeier designed air cooling systems, including Central Park Theatre (1919) and Riviera Theatre (1920), both in Chicago. Later established his own company.

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

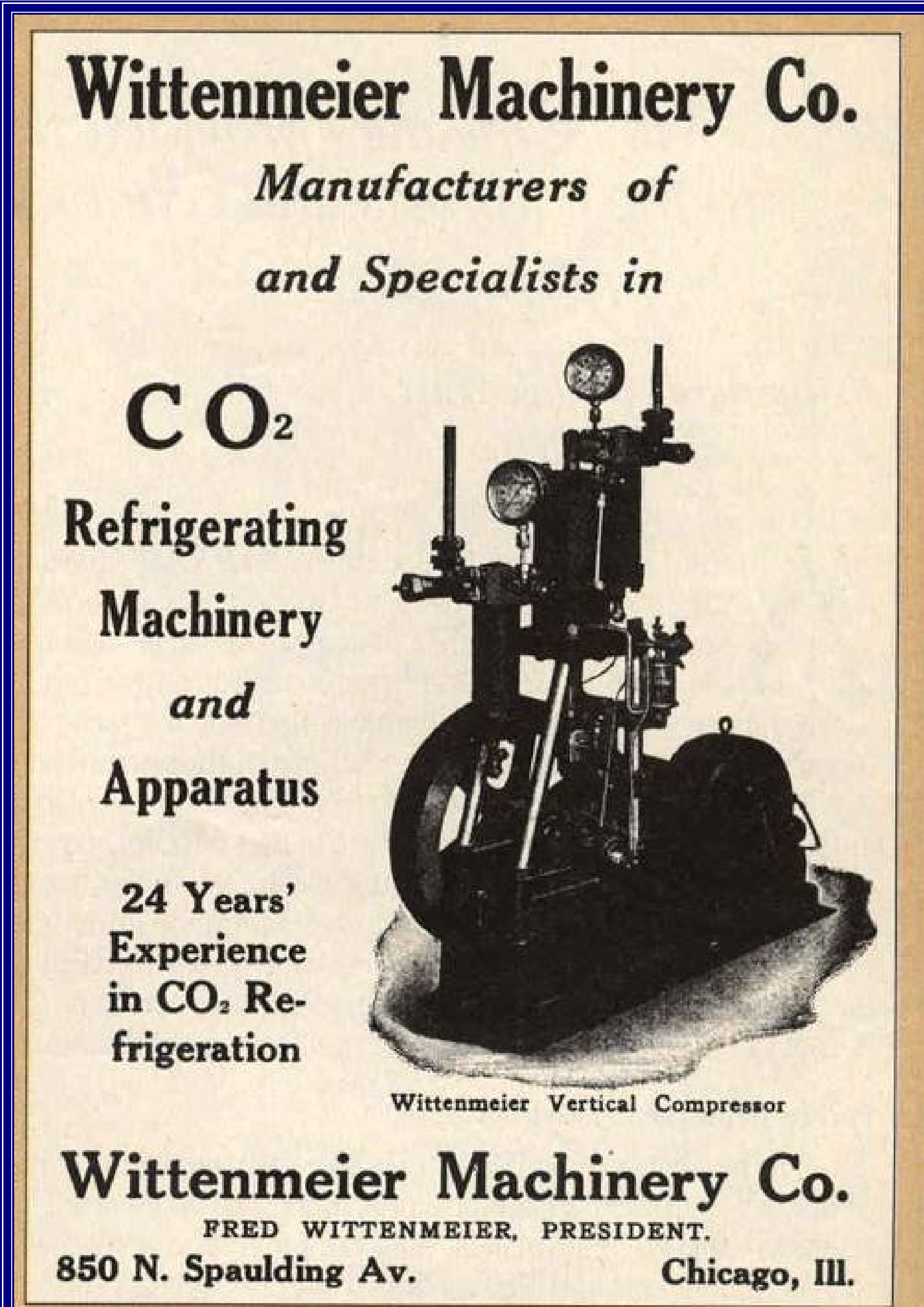

Figure 3 Frederick Wittenmeier was a pioneer in the installation of theater air conditioning systems. (*Ice and Refrigeration*. 1922. Vol. 63.)

(From "The 1920's: The First Realization of Public Air Conditioning," Bernard A Nagengast, ASHRAE Journal, January 1993)

When theater cooling began to take off in the second decade of the 20th Century, the danger of poisonous refrigerants in public places was addressed in several ways. The earliest movie theaters employed direct expansion systems using carbon dioxide refrigerating systems (see *Figure 2*). Such was the type said to have been installed in 1911 at the Orpheum Theater in Los Angeles using refrigerating equipment made by Kroeschell Brothers Ice Machine Company.[7]

This system was probably designed by Frederick Wittenmeier. Wittenmeier was a German immigrant to the United States who had practiced steamfitting. In 1896, he joined the heating contractor and boiler manufacturer Kroeschell Brothers Company in Chicago. Thereafter, he convinced Kroeschell to enter the ice machine business.[8]

Wittenmeier, who claimed to have introduced carbon dioxide refrigeration into the United States (using the patents of Julius Sedlacek), designed a number of air cooling systems beginning in 1905[9] (see *Figure 3*). Two of these systems were installed in the Central Park and Riviera Theaters in Chicago in 1919 and 1920, after Wittenmeier had left Kroeschell to establish his own company.[10]

The earliest motion picture theaters employed direct expansion systems using carbon dioxide refrigerating systems.[84] Such was the type said to have been installed in 1911 at the Orpheum Theater in Los Angeles using refrigerating equipment made by Kroeschell Brothers Ice Machine Company.[85]

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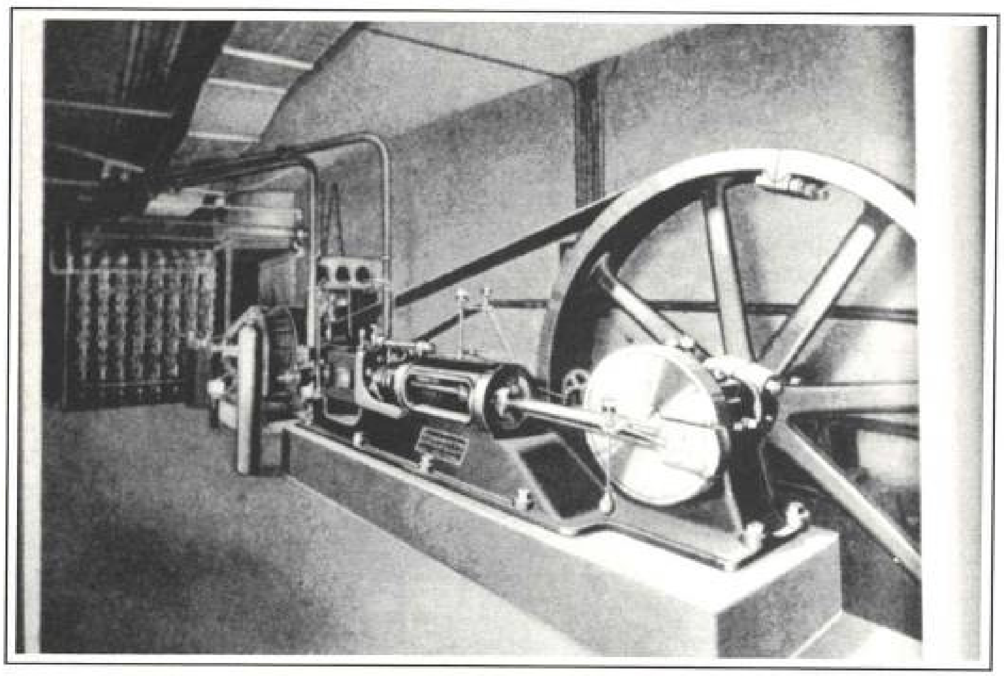

Figure 11-43 *Refrigeration systems for Balaban & Katz theaters in Chicago, 1919-1920. Refrigeration systems were installed in 1919 and 1920 to cool Balaban & Katz's Central Park and Riviera theaters in Chicago. The movie theaters were ornate in design, as seen in the view of the Riviera's auditorium. Both cooling systems used direct expansion carbon dioxide systems, with the Central Park theater's compressor shown in the lower view. Designed by Frederick Wittenmeier, a U.S. pioneer of carbon dioxide systems, both systems proved unsatisfactory because cool air was supplied at the floor. Patrons complained of drafts, even resorting to wrapping newspapers around their feet (from a catalog of the Wittenmeier Machinery Co., no date).*

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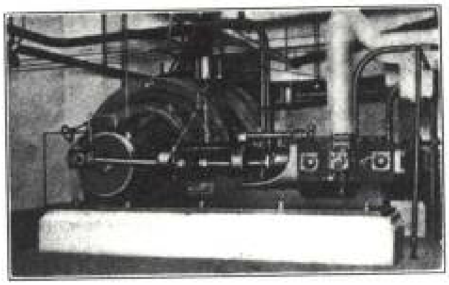

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Our experience is at your service. Full information supplied gladly upon request.

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PYTHIAN TEMPLE, New York, N. Y.
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MASONIC TEMPLE, Kansas City, Mo.
ILLINOIS ATHLETIC CLUB, Chicago, Ill.
UNION LEAGUE CLUB, Chicago, Ill.
N. Y. COUNTY COURT HOUSE, New York, N. Y.
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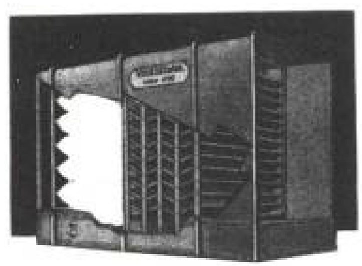
NEW BEDFORD HOTEL, New Bedford, Mass.
AMBASSADOR HOTEL, Chicago, Ill.
WINDERMERE HOTEL, Chicago, Ill.
AUGUSTINIAN FATHERS, Staten Island, N. Y.
BOARD OF EDUCATION, Chicago, Ill.
N. Y. TELEPHONE COMPANY, New York, N. Y.
NATIONAL CITY BANK, New York, N. Y.
WRIGLEY BUILDING, Chicago, Ill.
TRIBUNE BUILDING, Chicago, Ill.
KINGS COUNTY HOSPITAL, Brooklyn, N. Y.
CITY OF NEW YORK NURSES' HOME, Welfare Island, N. Y.
NORTH COMMUNITY HOSPITAL, Glen Cove, N. Y.
MICHIGAN CHILDREN'S HOSPITAL, Detroit, Mich.
ILLINOIS CENTRAL R. R. HOSPITAL, Paducah, Ky.
NORTHERN PACIFIC HOSPITAL, St. Paul, Minn.
LUCKEY PLATT DEPT. STORE, Poughkeepsie, N. Y.
HORNE DEPT. STORE, Pittsburgh, Pa.
CURTISS CANDY CO., Chicago, Ill.
ALBERT PICK & CO., Chicago, Ill.
TRIANON BALLROOM, Chicago, Ill.



Air washer and eliminator as installed by Wittenmeier-Vitolyzed-Air

One Contract---One Responsibility

WITTENMEIER—VITOLYZED—AIR

1926 BROADWAY—NEW YORK CITY

Figure 11-47 *Advertisement, air conditioning (from* The Heating and Ventilating Magazine, *July 1927, p. 181).*

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

By 1917 the idea of creating an indoor space that surpassed nature was linked to the economic competition between motion-picture theater chains. Motion-picture exhibitors promoted comfort as an integral part of a package of luxury, exoticism, and entertainment designed to lure customers. Costly air-conditioning systems soon became a necessary part of their competitive strategy. The way in which competition between exhibition companies fed the growing dominance of refrigerated air conditioning can be seen most clearly in Chicago. In October 1917 Chicago exhibitors Balaban and Katz opened the Central Park Theater. In planning the Central Park, the partners had sought to combine technical excellence with architectural splendor. The company hired the architectural firm of George and C. W. Rapp, because it "delivered what the Balabans wanted in theaters—a grand plan executed with taste."[40] The mythology of the Central Park is that Barney Balaban himself conceived the idea of adapting refrigeration to air cooling for the new theater. He took his idea to the Western Cold Storage Company in Chicago, where he had once worked, to ask the engineer there if it was possible.[41] Thus was born, the story goes, Chicago's first fully air-conditioned theater.

But between the idea and the implementation lay some tricky technical problems. One of the prime technical difficulties in developing comfort air conditioning was the safety hazard posed by the use of ammonia as a refrigerating agent. Ammonia was one of the most commonly used refrigerants, but engineers were well aware that it was a volatile chemical that presented the danger of explosion or toxic leaks. The toxicity of ammonia was judged an unacceptable risk around large groups of people; in other words, the risk was greatest in just those applications which could most benefit. These safety problems could be circumvented by remotely cooling a brine solution and circulating it through a cooling coil in the air path of the fan, but one engineer calculated that the expense involved in dropping the indoor temperature from 90

(From "Air Conditioning America," Gail Cooper, 1998)

degrees to 70 degrees purely with cooling coils without an air washer was "impracticable commercially."[42]

These problems were solved, not by Barney Balaban or anyone at Western Cold Storage but by Chicago engineer Frederick Wittenmeier. Wittenmeier was chief engineer for the Kroeschell Brothers Ice Machine Company from 1897 until 1917 and then headed the Wittenmeier Machinery Company from 1917 until his death in 1928.[43] He found a safe and economical solution to the problems of comfort air conditioning through the use of carbon dioxide as a refrigerant. Carbonic refrigeration machines were widely used in Europe but little known in the United States before 1900. Wittenmeier made several contributions to the technical refinement of early CO_2 machines in the United States, but his primary contribution was the commercial development of carbonic refrigeration in the United States.[44]

Under Wittenmeier's leadership, Kroeschell Ice Machine Company installed several early carbon dioxide fan-coil cooling systems, most notably in the Pompeiian Room and banquet hall of the Congress Hotel in Chicago in 1907, and in Frank Lloyd Wright's Larkin Building in Buffalo in 1909.[45] Then, sometime before October 1910, Wittenmeier took advantage of the safety and versatility of carbon dioxide to design an air conditioner that placed direct-expansion cooling coils within the spray chamber of the air washer itself. He filed patent applications for his designs in October 1910 and May 1911, assigning the rights to his employer Kroeschell.[46] Wittenmeier's incorporation of refrigeration coils into an air washer was explicitly aimed at the control of cleanliness, temperature, and humidity—in other words, at the development of an air-conditioning system.[47]

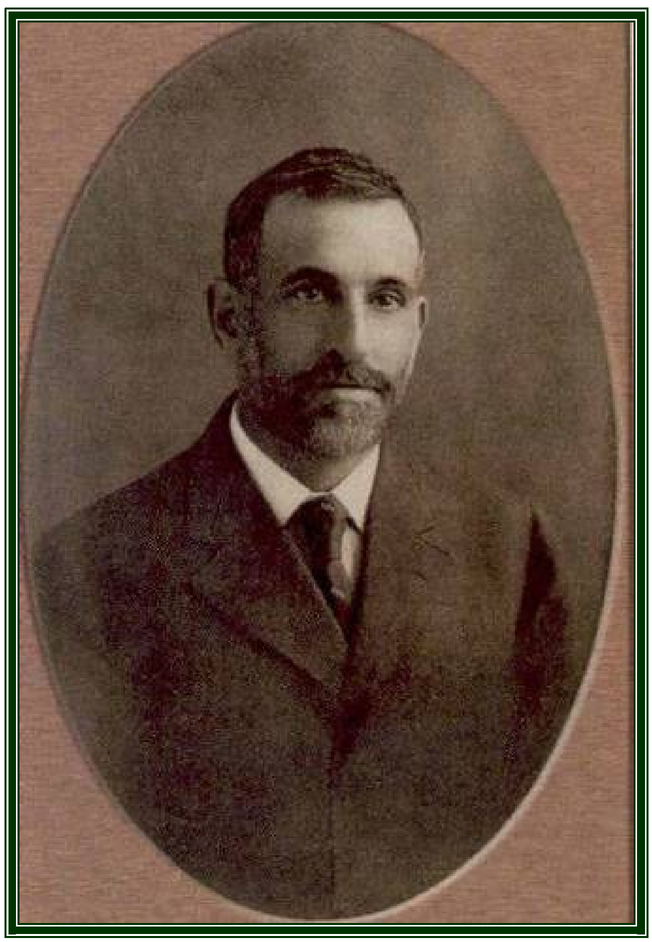
It is equally clear that he expected theaters to be an important market for his new system. A Kroeschell catalog explained that "modern people demand comfort and for this reason air cooling of public spaces has developed a tremendous field for refrigerating machinery using carbonic gas as a refrigerant. The moving picture theatre has done more to develop this field than any other type of institution."[48] The large motion-picture palaces with 2,000 to 4,000 seats often sold the same seats for three or four showings a day; Wittenmeier noted that "it makes a tremendous difference in the receipts if the house is filled 80% on average or only 40% or less."[49] With so much capital invested in their theaters, exhibitors could not afford a drop in attendance during summer. Air conditioning would draw in crowds and so defeat the traditional summer downturn. The air-conditioning system in Balaban and Katz's Central Park Theater incorporated many of the features of Wittenmeier's 1910–11 patents and was designed to produce an air temperature of 78 degrees inside the theater when the outside temperature was 96 degrees.[50]

The Central Park Theater opened Saturday evening, 27 October 1917, and was acclaimed for both its beauty and its technical innovations. *Moving Picture World* reported that the theater was "without a doubt the most palatial structure devoted to moving pictures in Chicago, if not in this country," while *Motion Picture News* declared that "the Central Park is a masterpiece." The *Motion Picture News* reported further that "never at any time in the motion picture history of Chicago did a house get the ovations from an opening night audience that was accorded this synthesis of all progressiveness in theatre construction." The two sets of brothers, Barney and Abe Balaban, and Sam and Maurice Katz, "who scoured the earth to bring together the equipment and devices that are found under the roof of this playhouse, were swept off their feet by the congratulatory wave that broke over them." Proclaimed "the acme of Chicago's achievement in theatre construction," the Central Park Theatre brought out motion-picture producers, exchangemen, exhibitors, and theater-supply representatives from all parts of the country who attended on opening night to get ideas on house construction.[51] It was that combination of local and national attention that made the Central Park air-conditioning system so influential. It provided a model for other Balaban and Katz theaters and a point of comparison for Chicago competitors. That pattern was repeated all over the United States. The trend toward multitheater holdings in the motion-picture exhibition industry accelerated the adoption of air conditioning, for a single executive decision could diffuse the technology throughout a national chain. The appearance of air conditioning in a theater belonging to a national chain could spark its rapid adoption at the local level, fueled by the intense rivalry of exhibitors.

The air-conditioning system in the Central Park Theatre certainly gave Balaban and Katz an edge over the firm's Chicago competitors. Barney Balaban recalled that "up until then no one ever thought of going to the theater in the Summer time. But we proved that we could do business fifty-two weeks a year."[52] The air-conditioning system proved so successful that Balaban and Katz made it a standard item in their chain of Chicago theaters, equipping the Riviera (1919), the Tivoli (1921), and the Chicago (1921) with similar systems.[53] The Wittenmeier Machine Company proudly advertised, "Cooling and Dehumidifying the air during the summer makes a theatre equipped with Wittenmeier System a profit producer."[54] Chicago engineer Samuel C. Bloom expressed more fully the economic benefits of air conditioning: "Good pic-

ALFRED R WOLFF

Born 1854? Active 1880-1915



Leading New York consulting engineer who designed the engineering services for many important buildings in New York, notably the air conditioning and co-generation systems for the Stock Exchange in 1901

[211] Alfred R. WOLFF

American consulting engineer in New York. Obtained mechanical engineering degree at age 17. Worked for Charles Emery, renowned consulting steam engineer, as assistant engineer for the U.S. Revenue Marine Service, then formed a consultancy partnership, Wolff & Weightman. Later, set up his own practice. Designed many important heating and ventilating systems and power plants, including the Seigel-Cooper Co. Department Store, the Hotel Astoria, St. Luke's Hospital, Carnegie Music Hall (1891, with provision for ice-block cooling), the New York Life Insurance Building, and the Metropolitan Life Building. In addition, he was the consultant for a number of large residences, such as the Cornelius Vanderbilt II house (1879-1883 and 1892) and the John Jacob Astor IV house (1891-1895). Used a variety of steam, hot water, and hot air systems. Applied heat transfer coefficients for building materials, developed from Péclet [27] and Box [30]. Wolff seems to have been the first to have introduced the scientific approach, as practiced in Germany, into the USA (from 1889), and it is believed he was aware of the methods of Rietschel [99]. Wrote *Artificial Cooling of Air for Ventilation* (1892). Designed cooling systems for the Cornell Medical School (1899) and the Hanover National Bank (1903). His best known achievement is the air conditioning of the board room and the cogeneration system for New York's Stock Exchange (1901), which employed three 100 ton (350 kW) ammonia absorption chillers fed by the exhaust steam from the engines that powered the electrical generators. He told the Stock Exchange Committee "the importance of this plan to the upper portion of the board room is in the abstraction of the moisture and the reduction of humidity. I attach less importance to the reduction of the temperature than to the abstraction of the moisture." Wolff's Stock Exchange (1901) has greater claim to be the first scientifically designed air-conditioning system (at least in the USA) than the Sackett-Wilhelms system (1902) of Carrier [101]. Wolff, a man of strict ethics and a charter member of ASME, refused to join ASHVE "because salesmen were permitted."

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

At the time the New York Steam Company was expanding its steam distribution, numerous commercial and residential buildings were going up throughout New York City. One of the most prolific and influential individuals involved in many of these projects was Alfred R. Wolff, a consulting engineer for the design and installation of heating and ventilating systems and power plants (Figure 7-74). Wolff designed many of the most important projects of the time including the Siegel-Cooper Co. Department Store, the Hotel Astoria, St. Luke's Hospital, Carnegie Music Hall, the New York Life Insurance Building, the Metropolitan Life Building, and others. His works also span the breadth of engineering practice in his use of steam, hot water, and hot air systems, all in a variety of configurations. He was one of the first to apply coefficients of heat transfer for different

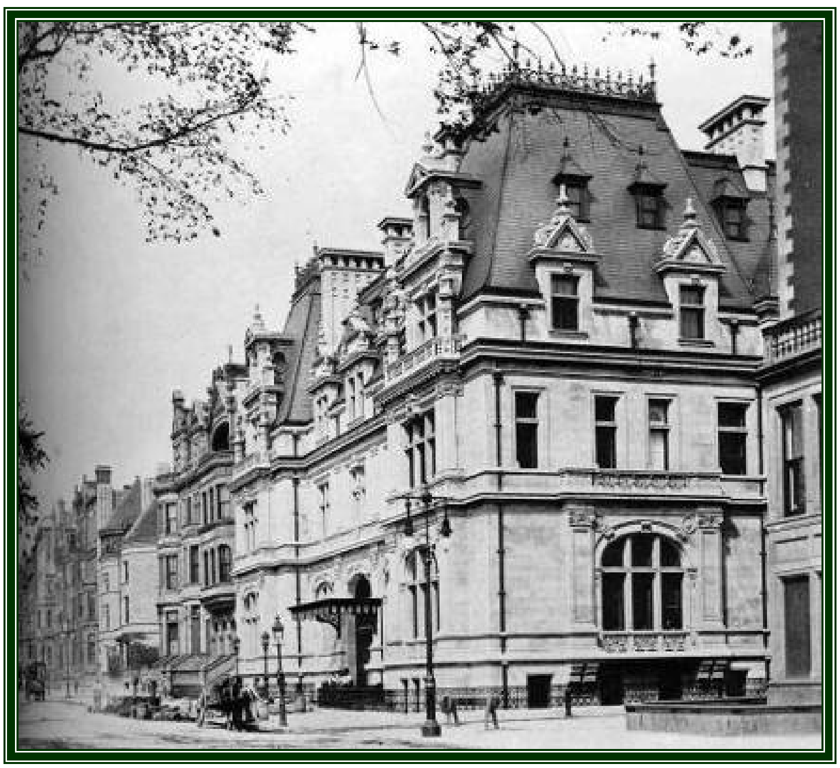
Siegel-Cooper Department Store, New York, 1896

The New York Astoria Hotel combined with its neighbour to form the Waldorf-Astoria, 1897

The New York Life Insurance Building, 1899 materials, initially developed by Eugéne Peclét and Thomas Box (Figure 7-75).

The New York Life Insurance Building (1896-99), designed by McKim Mead & White, architects, and Alfred R. Wolff, consulting engineer, was heated by steam from four water-tube boilers distributed through direct and indirect radiation. The system was controlled by thermostats from the Johnson Electric Service Co. The first seven floors were heated "by indirect radiation to 70_ in zero weather with a pressure of not more than five pounds by means of two central heating stacks and two of B.F. Sturtevant's 7-foot ventilating fans. Air filters clean all entering air from soot and dust. . . . For indirect radiation Bundy loop radiators and coils are used (A.A. Griffing Iron Co., Jersey City, N.J.). Radiators are placed in halls, vestibules, and toilets."[87]

Alfred R. Wolff was also the consulting engineer for a number of large residences, such as the Cornelius Vanderbilt II house and the John Jacob Astor IV house. The Cornelius Vanderbilt house (1879-83 and 1892), designed by Richard Morris Hunt and George B. Post, was a large French chateau-style mansion on Fifth Avenue between Fifty-Seventh and Fifty-Eighth streets (Figure 7-76). The heating and ventilating were provided entirely by ducted air distribution, which was gravity fed or induced



(Top) Cornelius Vanderbilt II house in New York, 1892
(Bottom) The John Jacob Astor IV house, also in New York in 1898

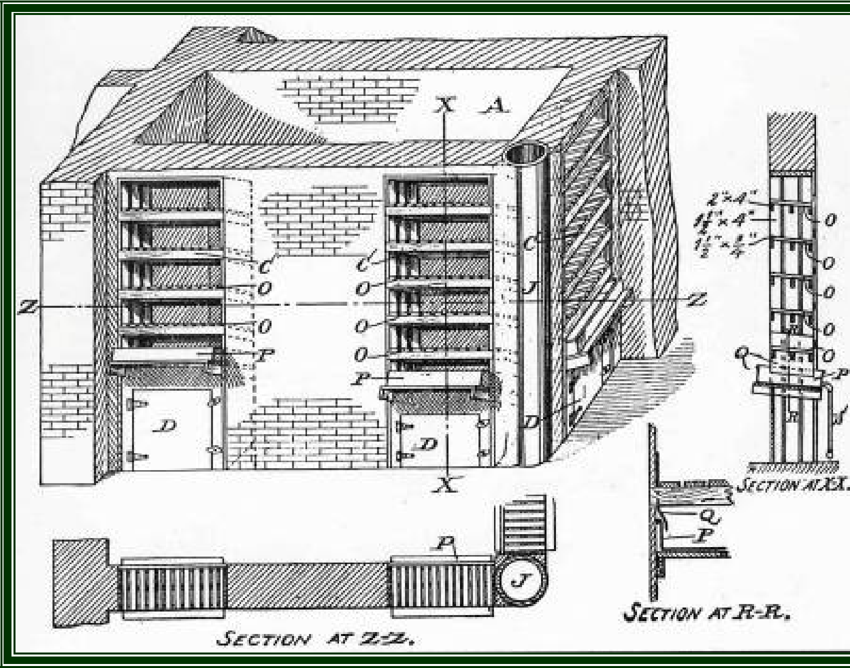
by indirect coils so that none of the system was under pressure. Fans were used only for exhaust. "Ninety-seven indirect stacks, having a total heating surface of 19,565 square feet, serve to warm the building, and to supply the hot air for this surface three horizontal tubular boilers are provided. . . . The ducts for supplying fresh air to the indirect stacks are divided into four general classes . . . (and) are provided with switch dampers by which the temperature of the air is regulated."[88] Hot water boilers provided heat from a central distributing tank (Figure 7-77).

The John Jacob Astor IV house (1891-95), designed by Richard Morris Hunt, was also in the French chateau style. The heating and ventilating were provided entirely by hot water, and air was distributed through heating stacks cased in galvanized iron with galvanized iron fresh air ducts leading to them. The building was ventilated by means of exhaust fans discharging into shafts provided for that purpose.[89]

Alfred R. Wolff's design for Carnegie Music Hall used large ventilating and exhaust fans to provide comfort for the main music hall. The heating and ventilation were provided by two 8-foot fans that discharged into a main distribution duct with a face area of more than 50 square feet. Exhaust was provided by fans located on the roof of the building (Figures 7-78 and 7-79).

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

(Top) The original Metropolitan Life Building is the low-rise block on the right in 1909
(Bottom) Carnegie Hall, 1899 (Both buildings in New York)
(Carnegie Hall photograph from “The Encyclopedia of New York City,” 1995)



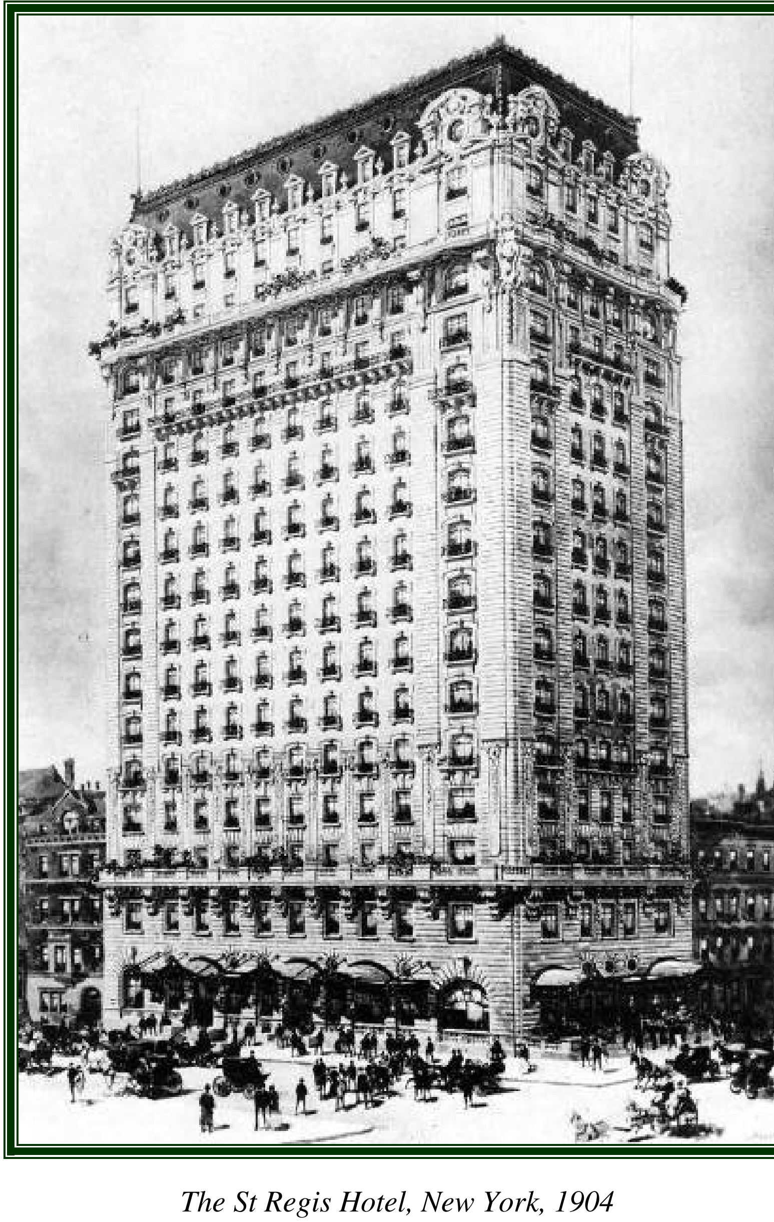
Ice-block racks in the cooling chamber, Carnegie Hall
(Ventilation & Heating," John S Billings, 1896)

"The selection of the special system of heating and ventilating to adopt in a particular building depends … on the structural possibilities; for, as important as are the heating and ventilation, owners and architects are not as yet quite ready to sacrifice other useful and artistic features … The engineer, therefore, if he would not have the heating and ventilating needs neglected, should be quick to recognize the system to adopt which will insure success, and will, at the same time, not prove a nuisance to the specific architectural and artistic interests of the building. Frequently, such a decision must be cast at a first inspection of the plans. Of course, there should be 'give and take' in this matter on both sides, and the purely decorative and structural interests should occasionally yield a point too. It is evident that the best result is achieved if the engineer who is to design the equipment be consulted when the original architectural plans are drawn, and before these plans have crystallized into definite and unalterable shape; for thus, in the harmony of co-operation, the best is accomplished by both the architect and engineer, and the engineering equipment, including the heating and ventilation, proves satisfactory, without encroaching on the highest architectural, structural and engineering possibilities and success."
Consulting HVAC engineer Alfred Wolff, addressing the Franklin Institute in 1894 on the heating and ventilating of large buildings.

"Alfred R. Wolff lately adopted a different device for ventilating tall buildings, but in that case it was the Hotel St. Regis (New York), fifteen stories high, and pretty thorough ventilation was wanted. Fresh air ducts equal to the requirements of the various floors would be so large at the lower floors that a wholly impracticable proportion of floor space throughout the building would be sacrificed to air ducts if the plant was in the basement."

"Mr Wolff, therefore, divided his ventilating plant into batteries of four, placing one unit each in the basement, third, seventh and twelfth floors, with indirect stacks supplied with steam by pipes from the boiler in the cellar."

from *The Heating and Ventilating Magazine*, October, 1904.



The St Regis Hotel, New York, 1904
(All illustrations of buildings, except where otherwise indicated, from "New York 1900," Robert A M Stern et al, 1995)

BIG COOLING PLANT IN STOCK EXCHANGE.

Three 150 Ton Machines Will Try to Keep the Brokers' Tempers Even—This Practically Marks the Opening of a New Era in Refrigeration.

INTERIOR OF THE BOARD ROOM OF THE NEW YORK STOCK EXCHANGE.

Figure 11-34 *The New York Stock Exchange, 1903. The New York Stock Exchange was the sight of the earliest true air-conditioning system successfully designed and operated for comfort cooling. The mechanical system was designed by heating and ventilating engineer Alfred Wolff, who consulted Henry Torrance, Jr., of Carbondale Machine Co. on the refrigeration system. Three 100-ton ammonia absorption chillers provided cooling for the cogeneration-type system that was designed to control humidity and temperature. The machines were powered by the exhaust from the steam engines that operated the electrical generators. The waste water from the refrigeration condensers was stored in roof cisterns and was then used to flush the toilets! Forty-two distribution boxes provided conditioned air through numerous inconspicuous small openings in the ornate ceiling of the "board room," resulting in a uniform downward movement of conditioned air at low velocity during summer months. This system was the forerunner of more sophisticated systems designed two decades later for movie houses, and remained in operation for twenty years (from headline in* Cold Storage, *May 1903, p. 206; illustration in* The Metal Worker, *August 5, 1905).*

The New York Stock Exchange

The scientific approach to heating and ventilating as practiced in Germany seems to have been first introduced into U.S. practice by heating and ventilating engineer Alfred Wolff after 1889.[45] A discussion of Rietschel's handbook by one of Wolff's associates (Arthur K. Ohmes) leads to the belief that Wolff was aware of Rietschel's work, including that on room cooling.[46] Wolff also may have read or heard Hermann Eisert's recital of Rietschel's methods in 1896, in which Eisert said:

> Under all conditions, however, it is advisable to fix the limit of the humidity of the air in the rooms to be cooled and to proportion the cooling apparatus correspondingly.[47]

Wolff, being a consulting engineer, responded to demand— and there was little demand for comfort cooling systems in the 1890s. Still, Wolff did design some cooling systems combining hot blast heating and cooling apparatus. Such systems were designed for the Cornell Medical College in 1899 and the Hanover National Bank in 1903.[48] The medical college system cooled the "post graduate dissecting room," thereby keeping both the live and the dead bodies cool! The system was used for graduation exercises during the summer. The crowning event in Wolff's cooling career, however, was the cogeneration system he designed for the New York Stock Exchange in 1901 (Figures 11-34 and 11-35). The system, originally designed to provide 450 tons of refrigeration from electric generator exhaust steam provided to ammonia absorption brine chillers, was to cool the Exchange board room and remove the machinery heat load from several basement levels. The system size was reduced just before installation to 300 tons and provided comfort cooling only to the board room.[49] The significance of Wolff's Stock Exchange job was that it was perhaps the earliest to recognize humidity control as a primary objective. To the building architect George Post, Wolff wrote:

The chief advantage of the cooling of the air, however, is that the degree of moisture in the air will be so considerably reduced. . . . The refrigerating plant as designed, will not only lower the air entering the room 8% to 10%, when the external temperature is say 85, but if the humidity of the entering air is say 85%, it will be lowered at the same time to about 55%. What this means in comfort, in ability to transact business, the health and well-being of the members, can scarcely be realized by a mere recital of the above figures, but must be experienced to be thoroughly appreciated. . . . If the refrigerating plant is instituted for the board room and the entering air is cooled . . . and the percentage of moisture lowered, the result will be that this room will be superior in atmospheric conditions to anything that exists elsewhere. It will mark a new era in the comforts of habitation.[50]

Wolff told the Stock Exchange building committee:

> I would like to say that the importance of this plan to the upper portion of the board room is in the abstraction of the moisture and the reduction of humidity. I attach less importance to the reduction of the temperature than to the abstraction of the moisture.[51]

Wolff's calculations of July and August 1901 show that the plant was designed to lower the board room temperature from 85°F to 75°F and the relative humidity from 85% to 55% for 3,570,000 cubic feet of air per hour, and that the entire cooling plant capacity needed was 420 tons.[52] Wolff's New York Stock Exchange system incorporated all the elements of modern air conditioning—humidity control (in winter also), temperature control, and filtering. The system was designed to provide specific results at a design condition. And the system, after design and installation, operated successfully for 20 years.

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

JASPER GUY WOODROOF
1900-1998

"Father of Food Science"

JASPER G WOODROOF **1900-1998**

Jasper Guy Woodroof is often called the "Father of Food Science." His contributions to research in food science and horticulture spanned a career of over sixty years. His work ranged from the development of processes and methods for the preservation of fruits and vegetables by freezing and canning to revolutionary techniques for the long-term storage of military rations.

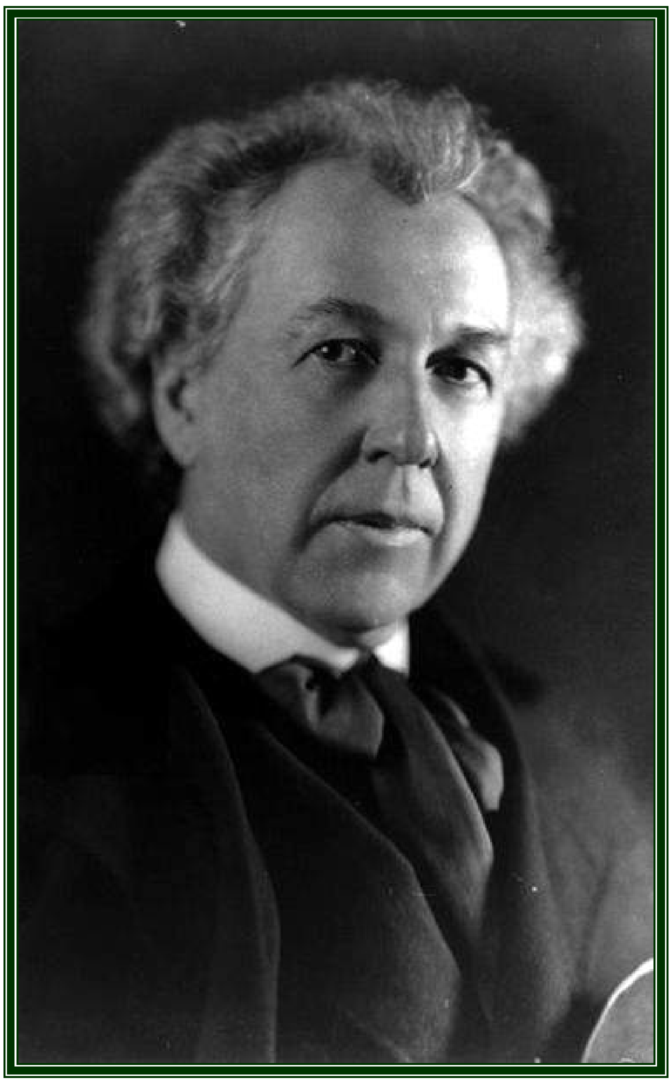
He graduated form the University of Georgia in 1922 with a BSA Degree in Horticulture and joined the Georgia Experiment Station and took studies that led to an MSA Degree from Georgia in 1926, and eventually a PhD from Michigan Agricultural College in 1932. Woodroof's contributions were made primarily while he was associated with the University of Georgia's Experiment Station from 1938 until his retirement in 1967.

Dr Woodroof published 48 bulletins and technical reports on horticulture. Between 1938 and 1987, when he published his exceptional autobiography "Dreams of a Food Scientist," he published four books and more than 250 bulletins and technical reports on food science. He founded the Department of Food Technology at the Georgia Experiment Station in 1939, which later became the Division of Food Science at the University of Georgia, with Dr Woodruff as its first chair.

A Life Member, Fellow and Distinguished Service Award recipient of ASHRAE, Woodroof served as a Regional Director of ASRE and as a "founding" Director of ASHRAE following the merger in 1959. He received many awards from other organizations as well, including Fellow of the American Association for the Advancement of Science and recipient of the Nicholas Appert Medal and the Donald K Tressler Award from the Institute of Food Technologists. Dr Jasper Guy Woodroof was inducted into the ASHRAE Hall of Fame in 2006.

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

FRANK LLOYD WRIGHT
1869-1928



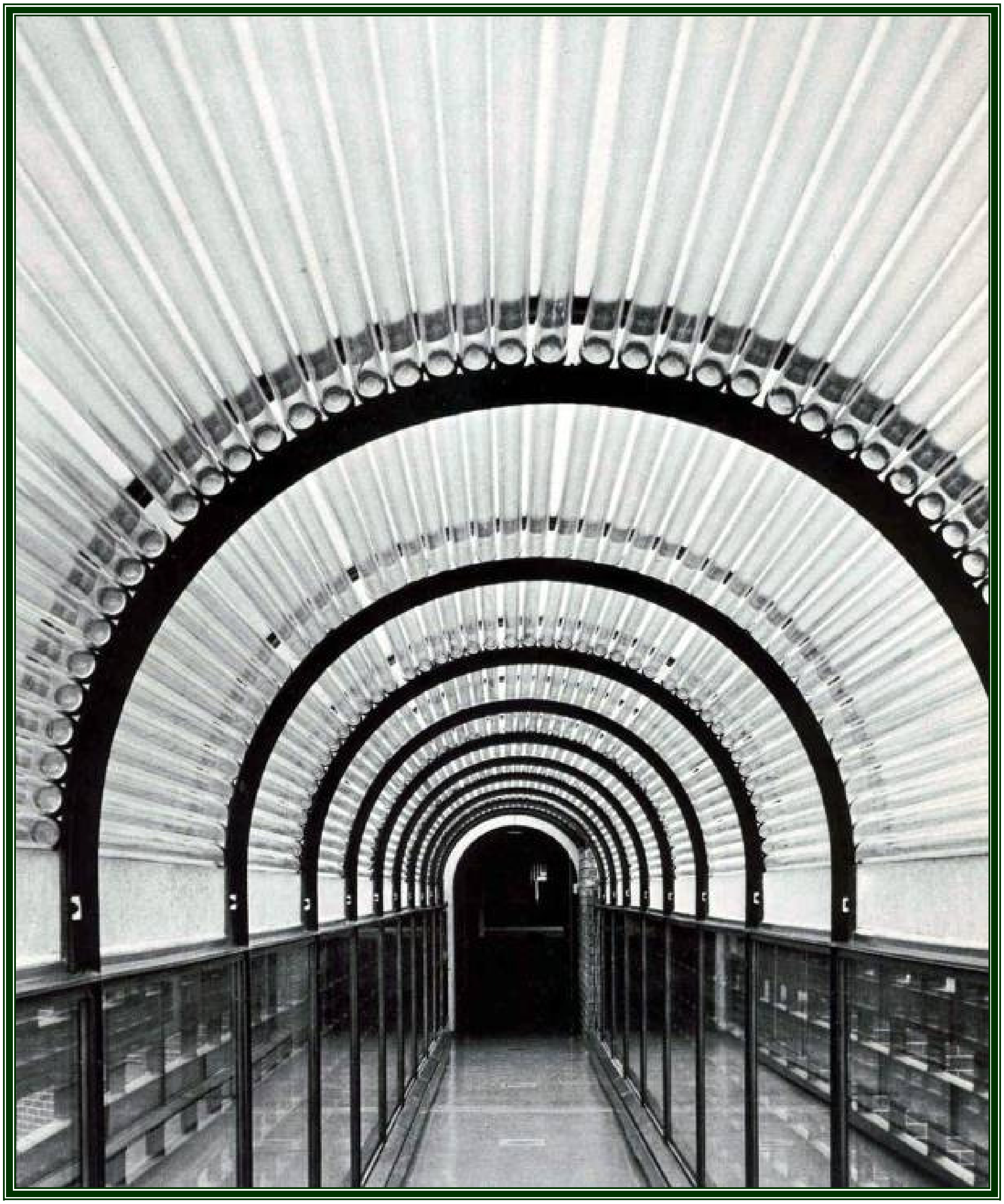
One of America's Greatest Architects

[201] Frank Lloyd WRIGHT **1869-1928**

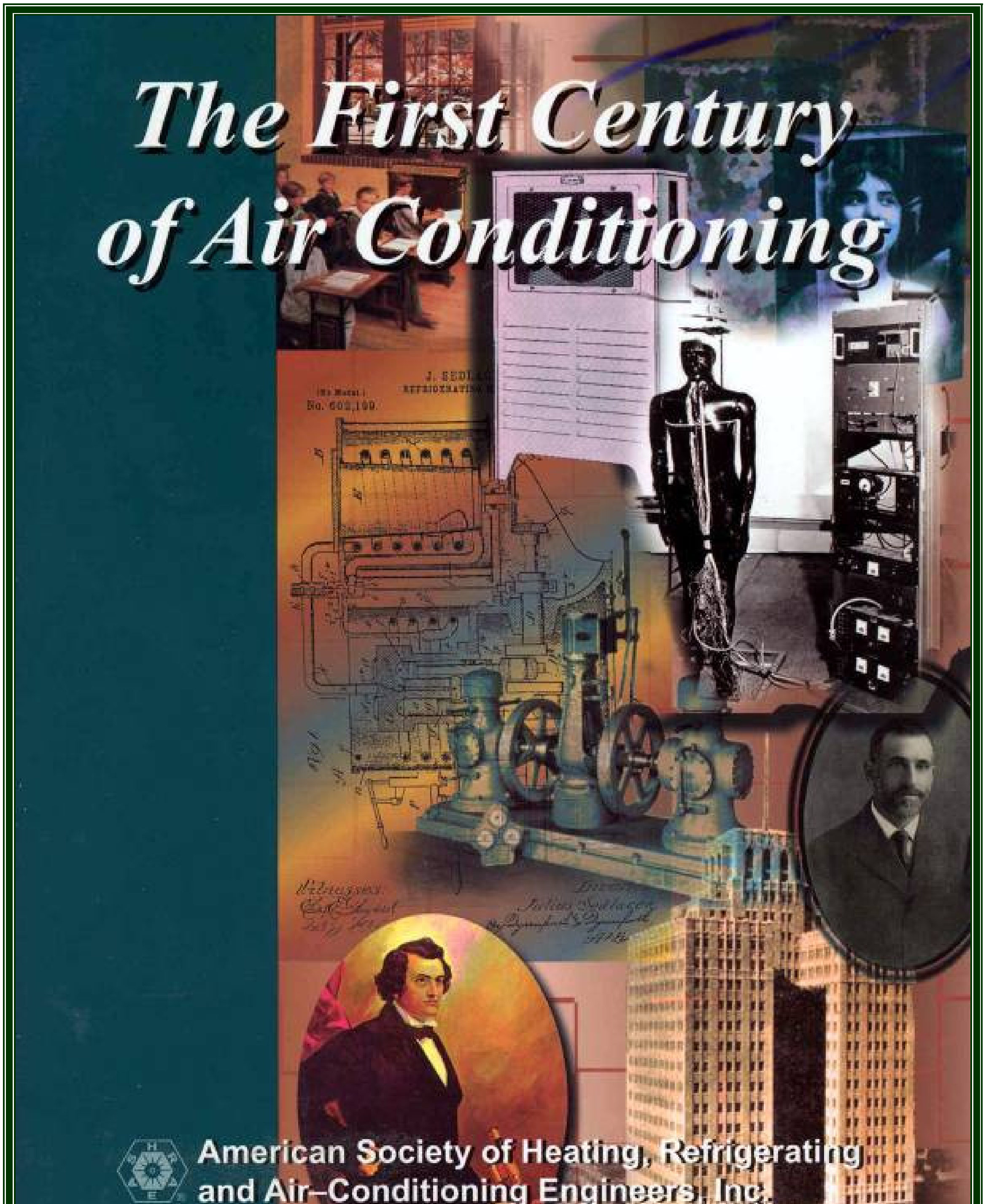
Generally considered America's greatest architect and ranked alongside Walter Gropius, Mies van der Rohe, and Le Corbusier [202] as one of the leading architects of the 20th century. Employed in his early years by Louis Sullivan [199]. Achieved renown for his domestic architecture, particularly in the Oak Park suburb of Chicago and later for his Prairie Houses. Designed many notable commercial and public buildings, including the Larkin Building, Buffalo (1904), the great Imperial Hotel in Tokyo (1922), the revolutionary Johnson Wax administration building in Racine, Wisconsin (1939), and New York's Guggenheim Museum (1959). For the Larkin offices (a mail-order business), the industrial nature of the site and the proximity of the New York Central Railroad, emitting fumes and noise, led Wright to design a large sealed inward-looking box, dependent on mechanical ventilation and overhead daylighting. He wrote, "The machinery of the various appurtenance systems, pipe shafts incidental thereto, the heating and ventilating intakes...are quartered in plan and placed outside the main building at the four outer corners...(with) the building practically sealed to dirt, odor, and noise." Later (1909), the Kroeschell Bros. Ice-Machine Company of Chicago added a CO_2 refrigerating plant to make the Larkin possibly the world's first air-conditioned office building.

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

Johnson Wax Offices, Racine, Wisconsin, 1939. Air conditioned by York. (From "Pfeiffer")



Pedestrian Bridge with glass-tubed roof, Johnson Wax Offices, Racine, Wisconsin, 1939
(From "Frank Lloyd Wright: Part I- Public Buildings," Martin Pawley, 1970)



1999 (CIBSE Heritage Group Collection)

The Larkin Administration Building

The first office building to break the mold was the Larkin Administration Building, designed by Frank Lloyd Wright and completed in 1906. The brief from the client[12] required a sealed building with mechanical ventilation. No mention was made of cooling, but Wright specified a refrigeration plant that distributed cooling water at 10°C (50°F) to air-cooling coils in the air-handling plants.[13]

The external appearance, form and massing of the building was dramatically different from architectural fashion at the time. Most U.S. architects were still designing offices in the "Beaux Arts" style with heavily ornamented facades. The Larkin building was large and squat. Wright described it in his 1943 biography[13] as a "simple cliff of brick hermetically sealed (one of the first air-conditioned buildings in the country)." The term "air conditioning" was practically unknown in 1906 and did not come into common use until the 1920s.

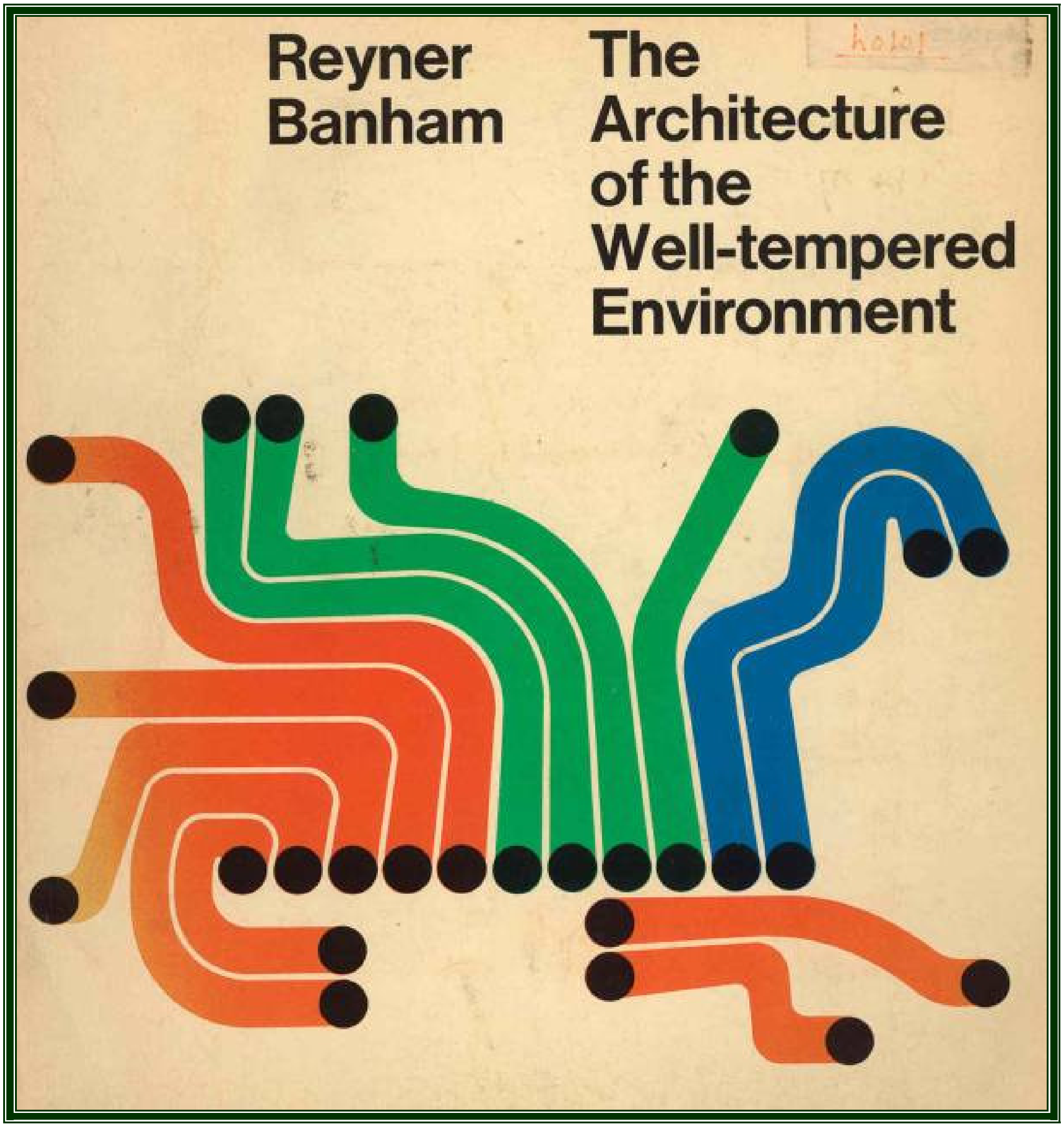
Although the building appeared distinctly different, in terms of the mass it resembled the "Chicago Quarter Blocks" that Wright was involved with when he worked in Louis Sullivan's architectural offices in the 1890s. It had a basement and five floors above ground, and the office space surrounded a large atrium with a glazed roof, or light court as it was called (*Figure 3*). This provided daylight to inner spaces on the floors above ground, even though the building had electric lighting throughout. The large windows had an unusually high sill, 1.5 m (5 ft) above the floor level, and no sun shading, in contrast to most buildings of the period.

(Text from "The Evolution of Modern Office Buildings and Air Conditioning," David Arnold in" The First Century of Air Conditioning")

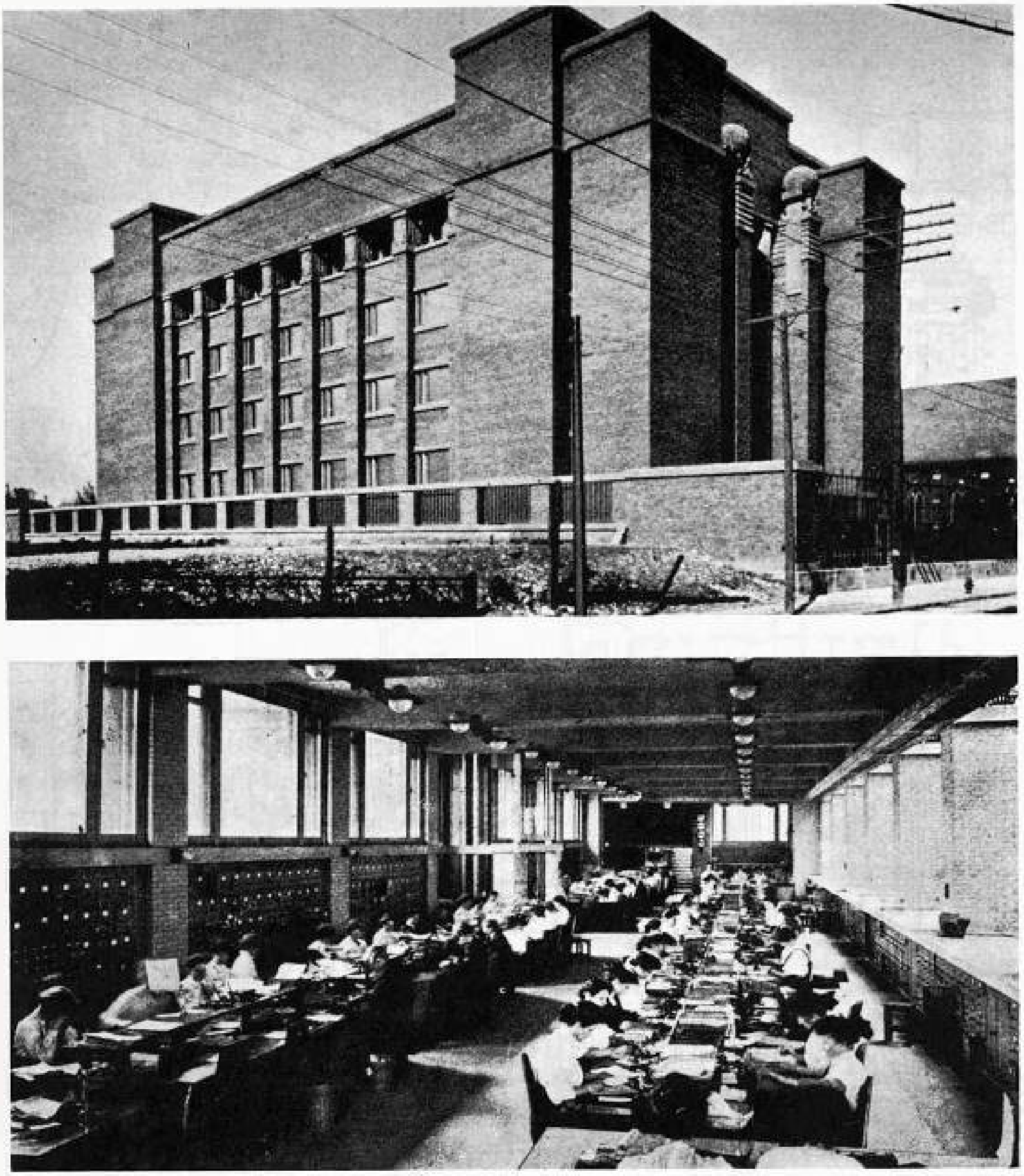
The mechanical ventilation system provided heating and cooling by 4 to 5 changes of full fresh air per hour treated in the basement air-handling plant. Air was exhausted from the offices at floor line in winter and from the ceiling in summer, presumably to maximize the respective heating and cooling effect. Although the cooling power was not great, by comparison with more recent systems, one can speculate that intrinsic features of the building would have meant that it was cool and comfortable in summer. These features that contribute to cool comfort include: the generous floor to ceiling height of 4 m (13 ft); the "thermal-mass" of the walls and ceilings; and the recessed windows. The only area where there was likely to be a lack of comfort was on the west side where clerks would have been in direct sunshine on summer afternoons. Later photographs show that blinds were eventually installed, presumably to minimize overheating.

The Larkin building was probably the first building designed to accommodate all the paraphernalia associated with modern air conditioning. Service ducts running from basement to roof were sited adjacent to staircases and expressed on the outside of the building. The ducts handled air drawn in and exhausted at roof level. Columns were extended with false sections to house steel supply ducts. Large areas of the basement were allocated to water storage and to air-handling plants drawing air from the top of the building. Although Wright specified a refrigeration machine, space was not allocated on the basement plan. Therefore, he might have been the first architect to underprovide space for an air-conditioning plant.

From the perspective of the history of air conditioning, this building is unique. Wright's design included working drawings of the ducting and plant and resolved many of the major issues decades ahead of other architects.



1969 (CIBSE Heritage Group Collection)

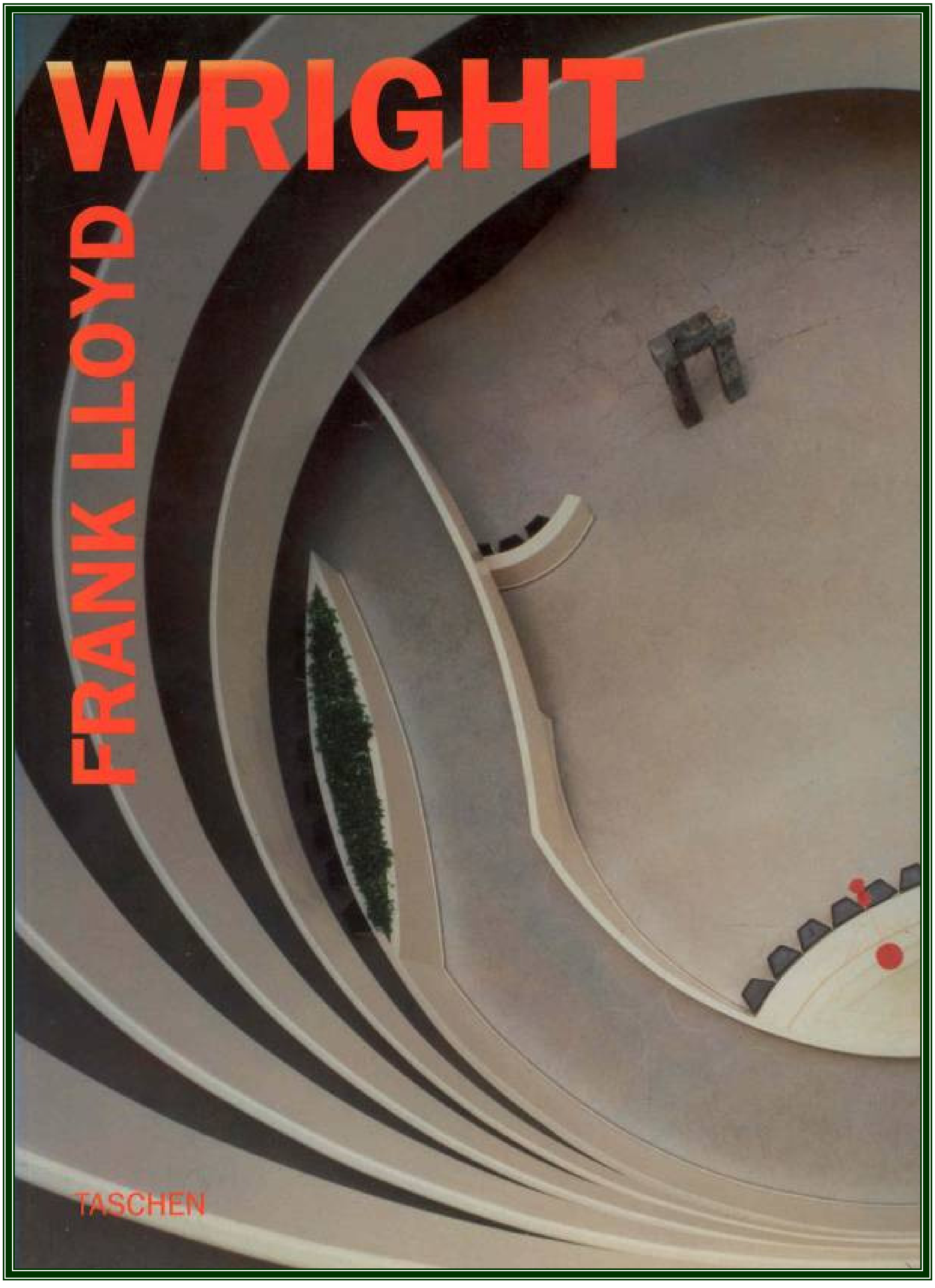


Larkin Building, Buffalo, NY, 1906 (from "Banham") tion for the parallel which Wright drew. In *The Architecture of the well tempered environment* Reyner Banham suggests in fact that the Larkin building was one of the first architectural masterpieces to be *derived* from a study of servicing requirements. He quotes Wright's *Autobiography* to the following effect:

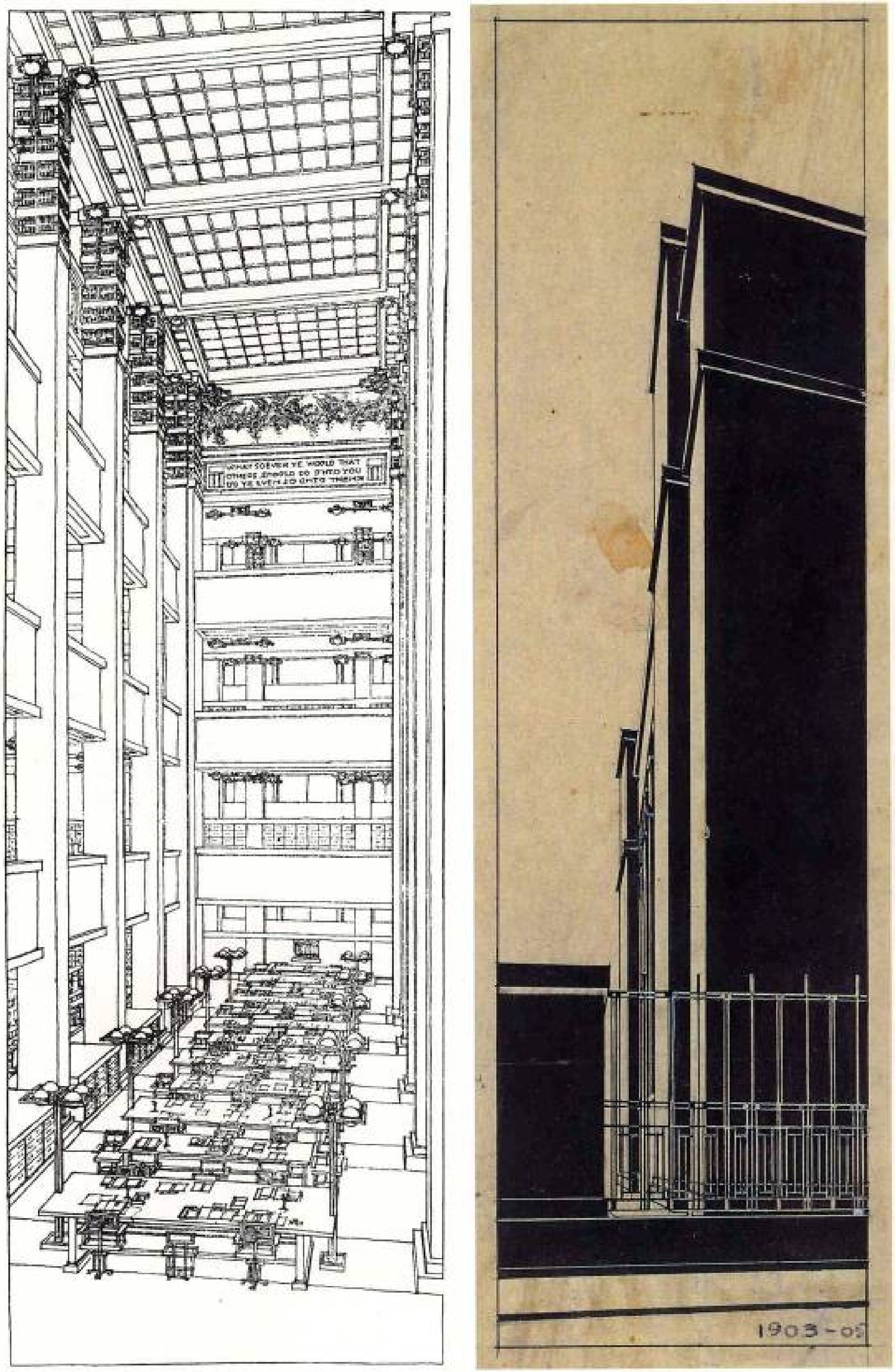
> 'I took the next train to Buffalo to try and get the Larkin Company to see that it was worth thirty thousand dollars more to build the stair towers free of the central block, not only as independent stair towers for communication and escape, but also as air-intakes for the ventilating system.'[4]

Here the building is seen primarily as a product of the functional needs of air conditioning. Even the famous central space, rising the full height of the building, and overlooked on all floors by open balconies, is seen as 'almost a necessity, given the then state of artificial ventilation.' There can in fact be little doubt that the Larkin building did require artificial ventilation—if only as a consequence of the fumes and noise emitted from the New York Central Railroad which passed beneath its windows; the characteristic corner towers clearly derive from the demands of this environmental system and thus it can be clearly seen that the *form* of the building was crucially influenced by them as Banham claims.

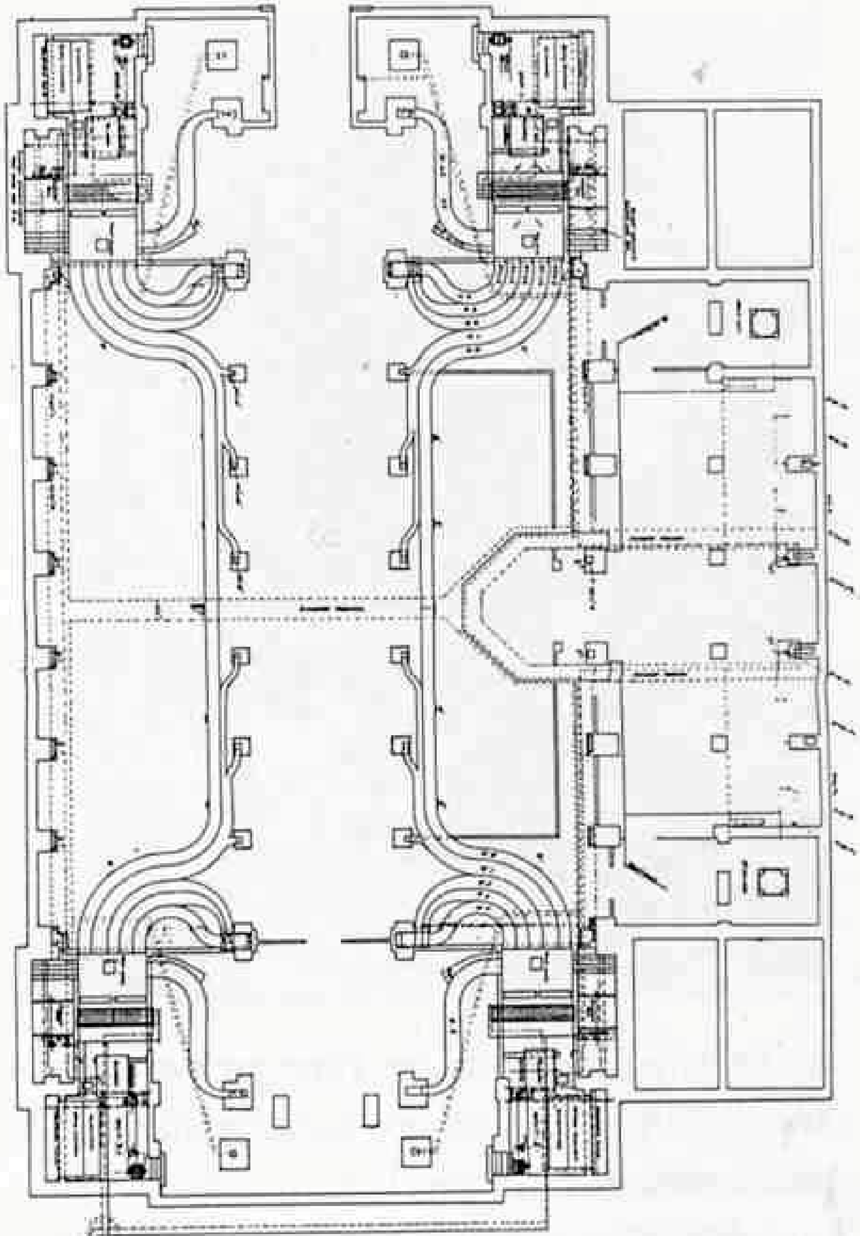
From "Pawley"



"Frank Lloyd Wright," Bruce Brooks Pfeiffer, 1991
(CIBSE Heritage Group Collection)



Illustrations of Larkin Building (from "Pfeiffer")



25 Untergeschoss-Grundriss des Larkin-Gebäudes mit den vier «Air Conditioning Units» unter den vier Treppen- und Luftkanaltürmen. (Quelle: Quinan)

Plant and Ductwork Layout for the Larkin Building
(From "Wie die Heizung Karriere machte," Sulzer, 1991)