The COMFORT DESIGNERS

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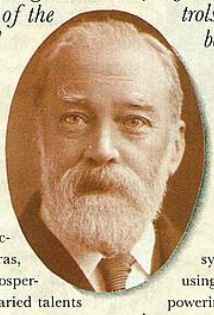
"AN ENGINEER AHEAD OF HIS TIME"

HENRY LEA ~ FOUNDER OF HOARE LEA & PARTNERS 1862 ~ 1987

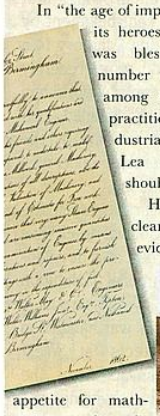
"The character of our engineers is a most signal and marked expression of the British character"
Gladstone.



If necessity is the mother of invention then for more than 50 years Henry Lea was surely one of its masters.

His career spanned and enriched both the Victorian and Edwardian eras, when British industrial prosperity was at a zenith. His varied talents helped bring comfort to the sick, a healthier environment to the public at large, and increased productivity to the new industrialists.

In "the age of improvement", as well as its heroes of invention Britain was blessed with a select number of men who were among the most successful practitioners of the new "industrial sciences". Henry Lea stood shoulder to shoulder with them.



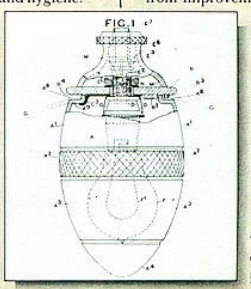
His school days were clearly marked with the evidence of a voracious appetite for mathematics and mechanics. Later, as a young apprentice with Messrs May & Mountain, "Engineers, Millwrights and Ironfounders", he displayed a rare gift for every one of the principal engineering disciplines: mechanical, electrical and civil. He was just 20 years old when he took charge of his first major civil project – a swivel railway bridge across the Clanrye River, in Newry.

Many early innovations sprang from his anticipation of the rapid development of public electrical power, especially in the lighting and air conditioning of large buildings.

"... extremely modern and ahead of its time in environmental controls. The first major building to be air conditioned for comfort".
Professor Reyner Banham

His work at the Royal Victoria Hospital, Belfast, created the world's first building to be air-conditioned for human comfort, with profoundly beneficial consequences for patient care and hygiene.

In addition, hot water for the heating system was produced using steam from engines powering the air conditioning fans; an early application of combined heat and power which helped the hospital to make important energy savings.



"In point of coolness and purity of atmosphere, the Incandescent Lamp stands unrivalled".
RW Winfield

In 1891, Henry Lea's electrical illumination of the Birmingham Town Hall for that year's music festival – one of the first public buildings to be so lit – prompted much favourable comment.

Music lovers were enchanted by an atmosphere of such comfort and clarity, and observed that there was "a sharp reduction in the incidence of fainting during the performance".

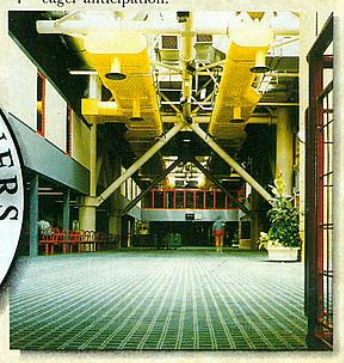
Musicians meanwhile were delighted by the cooler, brighter lighting. Now their instruments no longer went out of tune in the heat, and they could at last read their music clearly.

An unquenchable passion for enquiry and innovation also led Henry Lea to no less than 21 patent registrations; ranging from improvements to steam engines to the electrification of machinery and domestic appliances.

Today, 125 years on, the firm Henry Lea founded faces very different technological challenges, but the objectives remain unchanged, researching and deploying the latest engineering in pursuit of environmental quality and cost effectiveness for buildings.

Hoare Lea & Partners lead the development of the new technologies that will carry us into the next century. Technologies upon which a cleaner, calmer and safer world will be built; technologies that will solve mankind's most pressing energy and environmental problems.

Supported by an unrivalled tradition of professional engineering excellence, a history that spans both industrial revolutions and a proven dedication to innovation in design, the firm approaches the future with eager anticipation.



HOARE LEA & PARTNERS 125 YEARS 1862 1987

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The COMFORT DESIGNERS

Henry Lea begs leave respectfully to announce that, by the advice of many gentlemen well acquainted with his qualifications and experience, he has commenced practice as Consulting Mechanical Engineer.

Henry Lea, November 1862. From *Henry Lea, Consulting Engineer, 1839-1912.*

Alfred R. WOLFF [211]

Schemes and Estimates submitted free of charge for installations of Warm Air, Low Pressure Hot Water or Steam Apparatus.

PERFECT EFFICIENCY GUARANTEED.

JOHN GRUNDY,

. . . Heating and Ventilating Engineer,

MANUFACTURER AND PATENTEE OF

"HELIOS" and "SIRIUS" Smoke Consuming Grates for Chimney Pieces.
"HESTIA" slow and Quick Combustion Portable Warming and Ventilating Stoves.
"CALORIFER" and the well-known "GRUNDY" Smoke Consuming Central Fresh Warmed Air Heating Apparatus for Public Buildings and Private Dwellings.

27 MEDALS HAVE BEEN AWARDED.

Makers of Boilers, Ward Stoves, Radiators, Ventilators, & Ranges.

BOOK CONTAINING A THOUSAND TESTIMONIALS FORWARDED ON APPLICATION.

The well-known firm of **HAMPTON & SONS, Pall Mall East, London, S.W.,** write:

Mr. JOHN GRUNDY, 30, Duncan Terrace, London, N.

Nov. 5th, 1903.

Dear Sir,

In response to your letter of the 3rd inst., we have much pleasure in stating that your Heating Apparatus is used with great success at our Depositories at Battersea. The best proof of our satisfaction is that we are having your Heating Apparatus installed into our additional blocks of Depositories now in course of erection. We are of opinion that for safety, hygienic and all useful purposes, your mode of heating is the best. We have no trouble in working the apparatus, which is simple and very efficient. We have pleasure in giving you this testimonial, and wish you the success your system deserves.

Yours truly,
HAMPTON & SONS,
W. HAMPTON, Managing Director.

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Show Rooms and Work Rooms:

Torrens Street, Islington, N., & 393a, City Road, London, N.

Factory: THE TYLDESLEY IRON WORKS, nr. MANCHESTER.

Telegrams—"JOHN GRUNDY," LONDON. National Telephone—No. 552, KING'S CROSS.

31. *Advertisement: Heating and Ventilating Engineer, Manufacturer and Patentee. John Grundy, City Road, London. (Grundy was the first President of IHVE, 1898.)* Heating by Hot Water, *Walter Jones, 1904, p. xv.*

[203] Wilson Weatherley PHIPSON 1838-1891

English civil engineer, specialized in heating and ventilation. Worked as a consultant and sometimes in a contracting capacity. Educated in Brussels and Paris. Later, a pupil of Dr. Van Hecke of Brussels "who discovered a new method of heating and ventilating which had already given some very satisfactory results." Assisted Van Hecke to warm and ventilate the hospitals Necker and Beaujon in Holland. Came to London (1859) "with the object of introducing a new system of heating and ventilation devised by his old master Van Hecke." Phipson employed mechanical and natural ventilation systems, often together, with varying degrees of success. He was both a pioneer and an innovator. He carried out a number of important projects including Baron Rothschild's residence and bank, the Strand Music Hall (1864), Glasgow University (from 1864), Royal Holloway College, Egham (1882); and in London: the Natural History Museum (1873, and where he beat the firm of Haden in competitive tender), Royal Albert Hall (1871), Alexandra Palace (1874), and the Empire Theatre in Leicester Square (1890). Was also involved (1886) in the early development of the Prudential Assurance building in High Holborn, where he specified steam-driven dynamos with the exhaust steam used for space heating—an early example of combined heat and power. His scheme for the warming and ventilation of St. Thomas's Hospital (1865) was not successful. Was an advocate (c. 1888) of the American developments in steam district heating and of the Boston *Prall* high-temperature hot water heating system. He killed himself through overworking and excessive travelling (over 3000 miles in a fortnight). His practice was taken over by Ashwell and Nesbit [232 and 268].

82. *Barber.* **55.** *Cook and Hinchcliffe (Natural History Museum). His life and achievements are summarized in* Wilson W. Phipson: A Memoir, *a privately published appreciation, 1892. (The CIBSE Heritage Collection holds a Phipson Archive with some 50 items, many original, comprising letters, hand-written notes, sketches, invoices, reports, cost sheets, testimonials, etc. No portrait or likeness of Phipson has yet been discovered.)*

[204] Major Joshua JEBB active 1850

English military officer. Royal Engineers. Responsible for the design and construction of Pentonville Prison (1840-1842), London. This was considered a landmark, both in the design of the prison itself and in its services.* He employed Haden [223] to assist with the design and to carry out the installation, which included for the boiler feed water to be pumped by hand by 12 men in the cells. Jebb wrote, "An equable temperature of from 52°F to 58°F has been maintained in all the cells under circumstances of great variation in external temperature. The consumption of fuel has not exceeded from 2 to 2-1/2 cwt of coal for sixty-six cells, and the ventilation or quantity of fresh air introduced into each cell has been from 30 to 45 cubic feet per minute. The cost of maintaining this temperature and ventilation has been about 1/2 d per cell for 24 hours." He also noted, "the greater fuel consumption in a newly-built structure which has not thoroughly dried out." The tradition of Royal Engineers' prison-building was carried on by Du Cane [196].

Services in the Clink, B.M. Roberts, Building Services *(CIBSE Journal), January 1990. Within these Walls, K.W. Dale,* Building Services *(CIBSE Journal), December, 1992 with photo portrait.* **98.** *Billington and Roberts, pp. 205-207. See also* **105.** *Roberts, p. 110. *Copies of the Commissioner's Report on the Ventilation and Warming by Jebb and others, including a letter to G. and J. Haden are held at* **85.** *Haden Archive, WRO-1325.*

[205] Robert BRIGGS 1822-1882

American civil engineer. Consulting engineer of Boston. Worked with Nason [206] for Meigs [207] on the heating and ventilating installation for the United States Capitol in Washington [from 1855]. The design of the giant fans was based upon methods suggested by Péclet [27] and on a study by Briggs of the workings of a 1/10th scale model. "The passages in which were located the large centrifugal fan rotors...were so shaped that no fan casing was required. The central cone of the fan was of cast-iron; the vanes were of wood, stiffened and fastened with metal angles and rods. The rotor was 14 feet in diameter."* His design was described in his paper, *On the Conditions and Limits Which Govern the Proportions of Rotary Fans* (Institution of Civil Engineers, 1869-1870). Jointly obtained a patent with Nason (1863) "for a steam radiator made up of vertical tubes screwed into a horizontal cast-iron base" (often called the *Nason* radiator). Briggs wrote a number of essays covering ventilation, moisture in the air, and heating of halls of audience. Editor of the Journal of the Franklin Institute (1876-1878).Wrote the textbook (1882), *American Practice in Warming Buildings by Steam* with additions by Wolff [211]. Briggs received the Watt Medal and the Telford Premium from the Institution of Civil Engineers (1871).

Memoir of Robert Briggs, ASCE, Vol. 22, 1896, pp. 567-569. **3.** *Ferguson (including notes 52 and 53, p. 184). See also* **99.** *Donaldson and Nagengast, pp. 78-80. *Another report describes two fans, one 16 ft and one 12 ft in diameter.*

[206] Joseph NASON 1815-1872

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

99. *Donaldson and Nagengast, pp. 76-78, 84, and 195. See also Walworth, 1842-1942, J.A. Murphy. Walworth Company, 1942, and The Early Days of Steam Heating, A.C. Walworth,* Heating and Ventilation, *15 June 1893. A biography is:* Gallant Heritage, *Alice King, Vantage Press, 1965.*

[207] General Montgomery Cunningham MEIGS 1816-1892

While a Captain in the U.S. Army Engineers, Meigs was appointed (1853) by the Secretary of War, Jefferson Davis, to be Superintendent at the Capitol for the rebuilding and enlargement. This placed him over the architect, Thomas U. Walter, and gave him responsibility for coordinating the overall design and installation of the heating and ventilating system. Meigs appointed Nason [206], who in turn enlisted the help of Briggs [205]. Though the House of Representatives moved in 1857, followed by the Senate (1859), the relationship with Walter had deteriorated to the point where Walter refused to share his drawings (reminiscent of the similar feud between Barry [191] and Reid [58] during the rebuilding of the Houses of Parliament.) Meigs (like Reid) was dismissed (1859). Later (1861) he noted, the system having been in use for some time, that it "realized all that I undertook to accomplish in regard to light, warmth, ventilation and fitness for debate and legislation." This opinion was not unanimous. Later (1881-1887), Meigs was responsible for the oldest and one of the largest atrium buildings in the USA—the Old Pension Office in Washington (now, appropriately, the National Building Museum). "One of Meig's primary concerns was the welfare of the workers and the pensioners who visited on a monthly basis. He wanted a thoroughly ventilated building with no dark passages or corners, but curiously the building has no skylights; all natural light for the atrium enters through clerestory (double-pane) windows."

3. *Ferguson.* **97.** *Chap. 12.* **99.** *Donaldson and Nagengast, pp. 78-80. See also* **76.** *Rosenbaum, pp. 44-45 (Pension Office). Portrait from* **119.** *p. 421 (Courtesy National Archives, Brady Collection).*

[208] Henry LEA 1839-1912

English consulting engineer whose expertise ranged widely over the civil, mechanical, and electrical disciplines. Opened an office in Birmingham (1862) and issued a circular letter, "Henry Lea begs leave respectfully to announce that by the advice of many gentlemen well acquainted with his qualifications and experience, he has commenced practice as a Consulting Mechanical Engineer." He may have been the first in the field to describe himself thus, though Phipson [203] was also active around this time. Lea was a pioneer of electric lighting but also introduced new methods of artificial ventilation based on the plenum system of Key [98]. Used it with notable success at Birmingham General Hospital (1893). Then at the Royal Victoria Hospital, Belfast (1903), where, "A sprinkler system, used to moisten the filters through which the fresh air passed, was regulated on the basis of regular readings of wet- and dry-bulb temperatures. This conscious control of humidity gives the Royal Victoria Hospital a place among pioneering air conditioning systems."

78. *Tovey.* **79.** *Building Services.* **102.** *Banham, pp. 75-82. See also* **105**. *Roberts, pp. 102 and 115. Portrait from Hoare Lea & Partners.*

[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.

31. *Ingels, pp. 125-137.* **98.** *Donaldson and Nagengast, p. 287.*

[210] Frederic TUDOR, Jr. active 1880

American inventor and engineer. Son of the *Ice-King* [78]. Entered the heating business (1880). Said he was interested in "the comfort and convenience of the average citizen, and especially the average woman (who) had not been considered by steam heating engineers." Devised a "jacketed direct radiator with definite air supply and immunity from freezing" (USP 185,146: 1875) with the heat output controlled by an air damper. This was installed in the Hotel Cluny, Boston (1876). Tudor also invented a combination steam and hot water system (USP 278,636: 1883). Contributed much to the development of low-pressure steam systems. Invented a steam orifice (capillary) to control the rate of steam admitted to a radiator (USP 318,401: 1885). Also worked on the design of ventilating systems, including that for the Metropolitan Opera House (1883) and the Union League Club (1887), both in New York City. Though his steam systems did not attract much attention in America, they were well received in France and Germany. His system is sometimes referred to as the *French* system.

98. *Billington and Roberts, pp. 104-105.* **99.** *Donaldson and Nagengast, pp. 82-83 and 89. Portrait from* Heating and Ventilating Magazine, *June 1929, p. 113.*

[211] Alfred R. WOLFF 1859-1909

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."

81. *Nagengast.* **99.** *Donaldson & Nagengast, pp. 114-116 and 271-276. See also* **105.** *Roberts, fig. 60. Portrait on p. 93, from Robert Wolff family.*

[212] Walter S. TIMMIS died 1928

American consulting engineer, New York. Involved Carrier [101] in the design of the Sackett-Wilhelms printing plant (1902) and suggested trials using calcium chloride brine for dehumidification. President ASHVE (1919). Presidential Address proposed legislation for the protection of health and comfort.

31. *Ingels, pp. 15-19. Portrait from* **94.** *p. 178.*

[213] Konrad MEIER active 1900

American consulting engineer. Worked in New York. Wrote *Mechanics of Heating and Ventilating* (1912), which included a number of design charts* that were described by Pallot as "not so widely known as they should be, in view of the enormous saving in time and labor, together with the high degree of accuracy and the economy arising out of greater certainty...." Meier produced 10 charts covering pipe and duct sizing.

**Chart VII: Air Blast at High Velocities, included in the Pallot article. Charts I: Forced Hot Water Heating; II: HW Heating by Gravity; V: High Pressure Steam Heating; and VI: LP Steam Heating are in the CIBSE Heritage Collection, items 00238 to 00241. See The Meier Chart, AC Pallot, booklet of IHVE Summer Meeting, 1921.*

[214] Hugo THEORELL active 1902

Swedish consulting engineer from Stockholm. Listed as the first engineer from Scandinavia to be elected to ASHVE (1902).

94. *ASHRAE, pp. 79-80.*

[215] Kunisuke SEKIDO active 1903

Japanese consulting engineer. Worked in Tokyo. Listed as the first engineer from Japan to join ASHVE (1903).

94. *ASHRAE, p. 80.*

[216] Arthur H. BARKER 1870-1954

English contractor, consultant, author, and lecturer. Gained B.A. and B.Sc., London. Senior Whitworth Scholar (1895). Worked as a fitter for Henry Berry of Leeds (hydraulic engineers), draftsmen for Gwynne Pumps, engineer at Haden, Trowbridge, and then Technical Managing Director at J.F. Phillips, London. Later set up as consulting engineer. Invented (1903) a steam accelerator, called the *Cable System*, for increasing flow in hot water heating systems. Patented a method of radiant heating (1908) and now regarded as the *Father of Radiant Heating*. Published his classic textbook *Barker on Heating* (1912). Appointed the first lecturer on heating and ventilation at London University. Deduced (with Kinoshita) the 1.3 power law for radiator output (1918). President IHVE (1922). Twice awarded IHVE Silver Medal (1906 and 1909). The CIBSE Barker Silver Medal award is named for him.

107. *Billington.* **93.** *Proc. of IHVE 1922, with portrait. See also* **105.** *Roberts, p. 104.*

[217] J. Roger PRESTON 1878-1949

English contractor, then consulting engineer. Apprenticed to firm of A. Seward, Lancaster. Won first prize at IHVE Assistant's Competition two years running (1906-1907). Awarded Saxon-Snell Prize (1907) of Royal Sanitary Institute for his paper, *Suggestions for Improvements in Sanitary Appliances for Use in Workmens' Dwellings and Labourers' Cottages.* Later, won RSI Special Prize for *Heating and Ventilating of Public Buildings.* Worked for Walter Jones [240] of Jones & Attwood, Stourbridge, helping him with his researches. Then joined (1910) Maguire [241] at Maguire & Gatchell, Dublin, taking charge of the heating department. Later, became a director of Mumford Bailey & Preston, London. Set up (1924) as a contractor, later (1926) turning the firm into a consultancy practice. He developed an electric air speed meter (1907), a double-duct air-conditioning system (1909), and a *Heating Main Calculator* slide-rule. Preston was President IHVE (1929).

80. *J. Roger Preston & Partners with portrait.* **93.** *Proc. of IHVE, 1929. See also* **105.** *Roberts, p. 104.*

[218] Dr. Oscar FABER 1886-1956

English civil, electrical, and mechanical engineer. Made his reputation designing reinforced concrete structures. Chief Engineer, Trollope & Colls, when he worked on many important London buildings. Set up as a consulting engineer (1920). Acted as consultant to the Bank of England (1925-1942) for structure, heating and air-conditioning plant with Kell [219], and electrical systems. Responsible for numerous city banks and for the Earls Court Exhibition Building (1938). He advised on the design of Sydney Harbor Bridge and the Mersey Tunnel. Wrote (1936, with Kell) the standard textbook *Heating and Air Conditioning of Buildings.* President IStructE (1936). President IHVE (1944-1945, serving two terms). Awarded OBE for his work during the Second World War. Involved in the air conditioning of the rebuilt House of Commons (1943-1950), for which he was made CBE (1951). His biography (by his son John) reveals that in spite of his brilliance he was not always easy to work with.

77. *John Faber, with portrait.* **93.** *IHVE Journal, 1944.*

[219] John Robert KELL 1902-1983

English engineer. Initially worked as contractor. Joined (1926) the office of Oscar Faber [218]. He was deeply involved in all aspects of the building services design for the Bank of England, which involved on-site electricity generation with waste heat recovery. Wrote (1936, with Faber) the standard textbook *Heating and Air Conditioning of Buildings.* Later, his work on the 12-acre Earls Court Exhibition Building involved conducting full-scale tests on the special ventilating jet nozzles (*IHVE Journal*, March 1938). Taken into partnership by Faber (1948). Responsible for the air conditioning of the rebuilt House of Commons (1943-1950). President IHVE (1952). Remarked "that of the forty-five Presidents to date, only five have been consultants." Made CBE (1966). Awarded IHVE Gold Medal (1967). Associated with the Abbey Church at St. Albans for many years, Kell has the unusual distinction of having his bust, carved in stone, among the roof gargoyles.*

77. John Faber, Chap. 3 with portrait. **93.** *IHVE Journal, 1952. * Building Services (CIBSE Journal), April 1980, p. 56.*

[220] Gian Felise BERTOLINI active 1960

Italian consulting engineer. Associate Professor of Engineering at Milan Polytechnic. His projects include one of the first high-rise European office buildings (1960), the 32-floor Galfa Tower in Milan (air conditioned by induction units recessed into the floor). Also involved in cogeneration plant for Comasina district (1961), three major Milan hospitals (1966-1976), and the Carlo Felice Theatre, Genoa (1976). Founding President ASHRAE Italiana (1960). Served three terms as President of AICARR (ASHRAE Affiliate Society). Founded (with Paolo Sonino) the Mostra-Convegno Exhibition and Conference (1960). Later, founded and edited the magazines *AICARR Journal and Hospital Engineering* to which he was a frequent contributor. Inducted into ASHRAE Hall of Fame (1996).

ASHRAE Insights, *June 1996.*