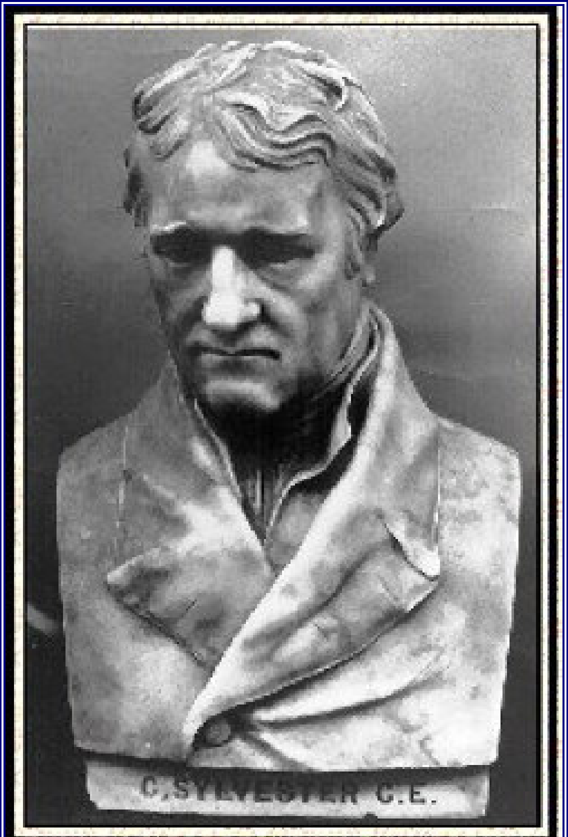
CHARLES SYLVESTER
1774-1828

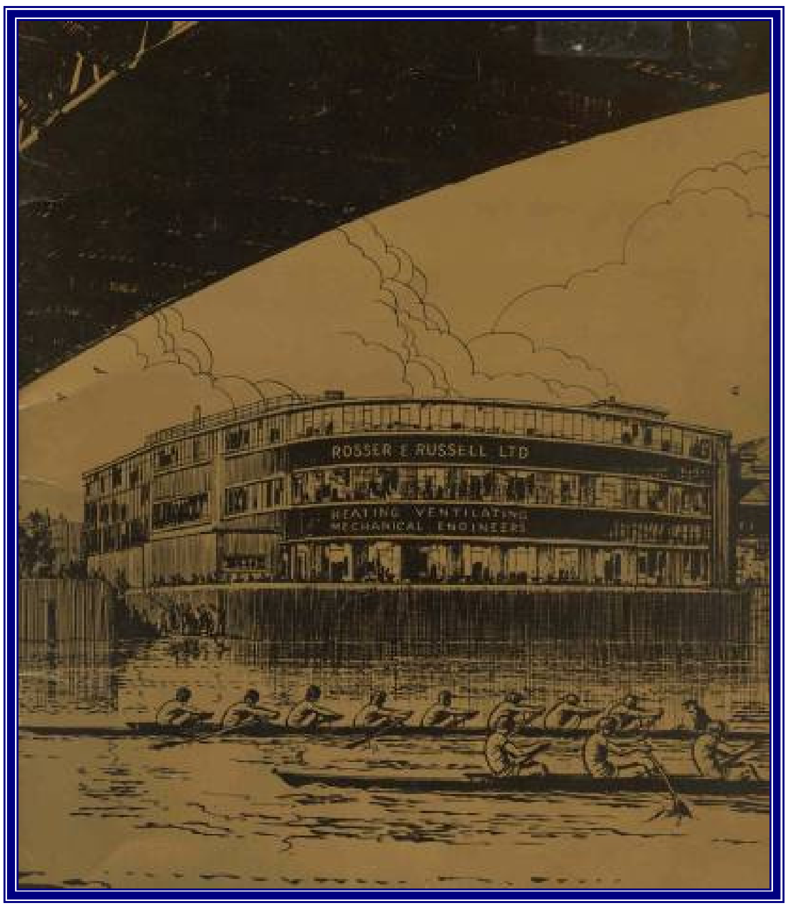


Bust of Charles Sylvester held at the Derby Museum.

[221] Charles SYLVESTER **1774-1828**

Sheffield "chymist" and mechanical engineer. It is said his inventive mind and industry led directly to the founding of contractors Rosser & Russell. He obtained a patent related to metal galvanizing (BP 2842: 1805). Later worked for William Strutt [22] at his Derby Foundry, who "certainly recognized his value as an engineer, for he soon had him working on the development and installation of ventilating systems" and on a heating scheme for Derby Infirmary. Wrote a treatise, *The Philosophy of Domestic Economy as Exemplified in the Mode of Warming, Ventilating, Washing, Drying and Cooking* (1819). Continued work as a heating engineer until his death, leaving his business to his son, John [222].

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



"Rosser & Russell Limited," Ian Murray Leslie, 1974
(CIBSE Heritage Group Collection)

Charles Sylvester and his times

1774, birth year of Charles Sylvester, the Sheffield "chymist" and mechanical engineer whose inventive mind and industry led directly to the founding of the great firm of environmental engineers Rosser & Russell Limited: What fermenting agencies were then at work in the heart of England? G.M. Trevelyan writes: "Between the classical world of the 18th-century with its self-confidence and self-content, and the restless England of Peterloo and the rick burnings, of Cobbett and Byron, were interposed twenty years of war with Revolutionary and Napoleonic France . . . particularly unfavourable to the better development of the grim factory towns of the North." Yet, the historian continues, "the skilled engineers and mechanics, the men who made and mended the machines . . . were in the forefront of invention, and rejoiced in leading the new age. Such workmen were the Stephensons of Tyneside; there was nothing 'middle-class' about the origins of the man who invented the locomotive after having taught himself to read at the age of seventeen . . . Such men were making the new wealth of England".[1]

Trevelyan was writing of George Stephenson; he could as easily have been describing Charles Sylvester, born the son of a poor "nailor" in 1774 in the West Riding hamlet of Norton, near Sheffield, yet afterwards named by the Sheffield historian Hunter, as "one of her most distinguished men".[2]

In common with Stephenson (whose project for the first public railway between Liverpool and Manchester he was engaged in 1824 to appraise), Sylvester received no formal education but at the age of 18 applied his energy and considerable intellect to teaching himself to read (in the intervals of supporting his family by his labours as a plated-wire worker) and to mastering the arts of sciences and mathematics. He was fortunate in one thing: 18th-century Sheffield was a forcing ground for inquiring minds like his!

(Text extract from "Rosser & Russell Limited")

In the early 1800s, Sylvester took out a number of patents. One was concerned with what he called "galvanised metal" – a method of coating sheet steel or other metals with zinc, an invention which may have led to the establishment of the galvanised sheet and tin-plate industry. Later he was to develop other inventions in a different field.

Sylvester's bust, probably by the Royal Academician Francis Chantrey and made about 1805, shows him as a man of intellect, firmness of purpose and principle. He possessed, it seems, a genius for friendship, and it was this last quality that induced him, in the winter of 1807, to remove himself and his young family to Derby where he took employment with William Strutt FRS, head of the Derby Foundry. The two men had met earlier in the year in Derby where Sylvester was giving a lecture on Galvanism. A mutual liking sprang up between them, and this continued until Strutt's death. Sylvester worked on the Derby Foundry as also on a heating scheme for the Derby Infirmary. According to Inkster's researches *ubi sup* "William Strutt certainly recognised his value as an engineer, for he soon had him working on the development and installation of ventilating systems".

Sylvester's philosophy for life – and work

In the introduction to his treatise "The Philosophy of Domestic Economy as Exemplified in the Mode of Warming, Ventilating, Washing, Drying and Cooking" published in London in 1819, Sylvester sets forth his philosophy for life, and perhaps for his life's work:

"If science really can contribute to the happiness of mankind, it must be in this department of life, the home, as the real comfort of the majority of men, particularly in this country, is sought for at their own firesides. How desirable, therefore, does it become to give men every inducement to be at home, by directing all the means of philosophy to increase domestic happiness".

In 1820 Sylvester moved with his family to London where, from his house in Great Russell Street, Bloomsbury, he continued his work as a heating engineer, chemist and man of science, by now being aided by his son John, and gaining greatly in reputation. In 1824 Charles Sylvester was appointed by the Committee of the Liverpool and Manchester Projected Railway to report on George Stephenson's first public railway. Four years later, he died at the age of 54, leaving to John his son, his patents and business.

THE

EDINBURGH
;DICAL AND SURGICAL
JOURNAL:

EXHIBITING

A CONCISE VIEW

OF THE

I' AND MOST IMPORTANT DISCOVERIES

IN

·EDICINE, SURGERY, AND PHARMACY.

VOLUME SIXTEENTH.

1820.

EDINBURGH:
Printed by George Ramsay & Company,
\RCHIBALD CONSTABLE AND COMPANY, EDINBURGH;
\.MAN, HURST, REES, ORME, & BROWN, LONDON;
AND JOHN CUMMING, DUBLIN.

1820.

(Google Books)

V.

The Philosophy of Domestic Economy; as exemplified in the mode of Warming, Ventilating, Washing, Drying, and Cooking, and in various arrangements contributing to the Comfort and Convenience of Domestic Life, adopted in the Derbyshire General Infirmary, and more recently, on a greatly extended scale, in several other Public Buildings newly erected in this Country; together with an Explanation of the Principles on which they are performed. The whole illustrated by numerous Engravings by W. Lowry. By CHARLES SYLVESTER, Engineer. Nottingham, Barnet, and London, Longman & Co., 1819. 4to, pp. 62, with Ten Plates.

THE Infirmary at Derby has been spoken of in such terms of approbation, that we have long wished for a description of it; and Mr Sylvester, the editor of the present volume, has fortunately every qualification for this task, his skill as a chemist and engineer being well known to the public, and his residence at Derby having afforded him the best opportunities of appreciating the value of the contrivances which he describes: it is, however, to *William Strutt*, Esq., of Derby, that the inventions which distinguish this establishment are primarily due, and they certainly reflect the highest credit on the philanthropy and perseverance, as well as the ingenuity of that gentleman. The volume before us is valuable, likewise, in a more extended view, since it illustrates several principles of great importance to the comfort and convenience of domestic life, which, if well understood, are calculated to assist materially the measures of the practitioner in medicine, or, what is still better, to prevent the occurrence of disease. It is not possible, without the assistance of plates, to lay before our readers a detailed account of the edifice now under our consideration, but we shall endeavour

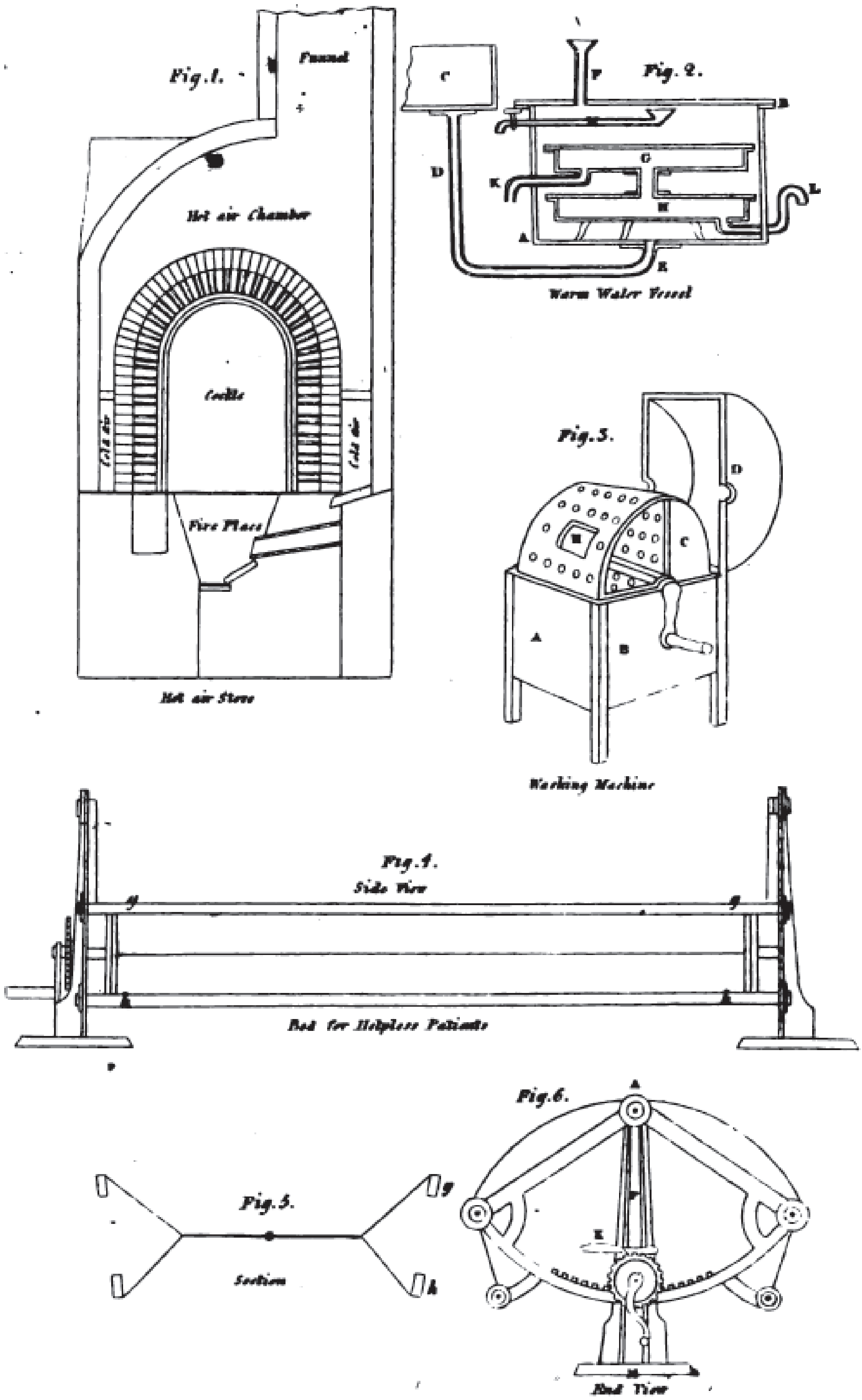
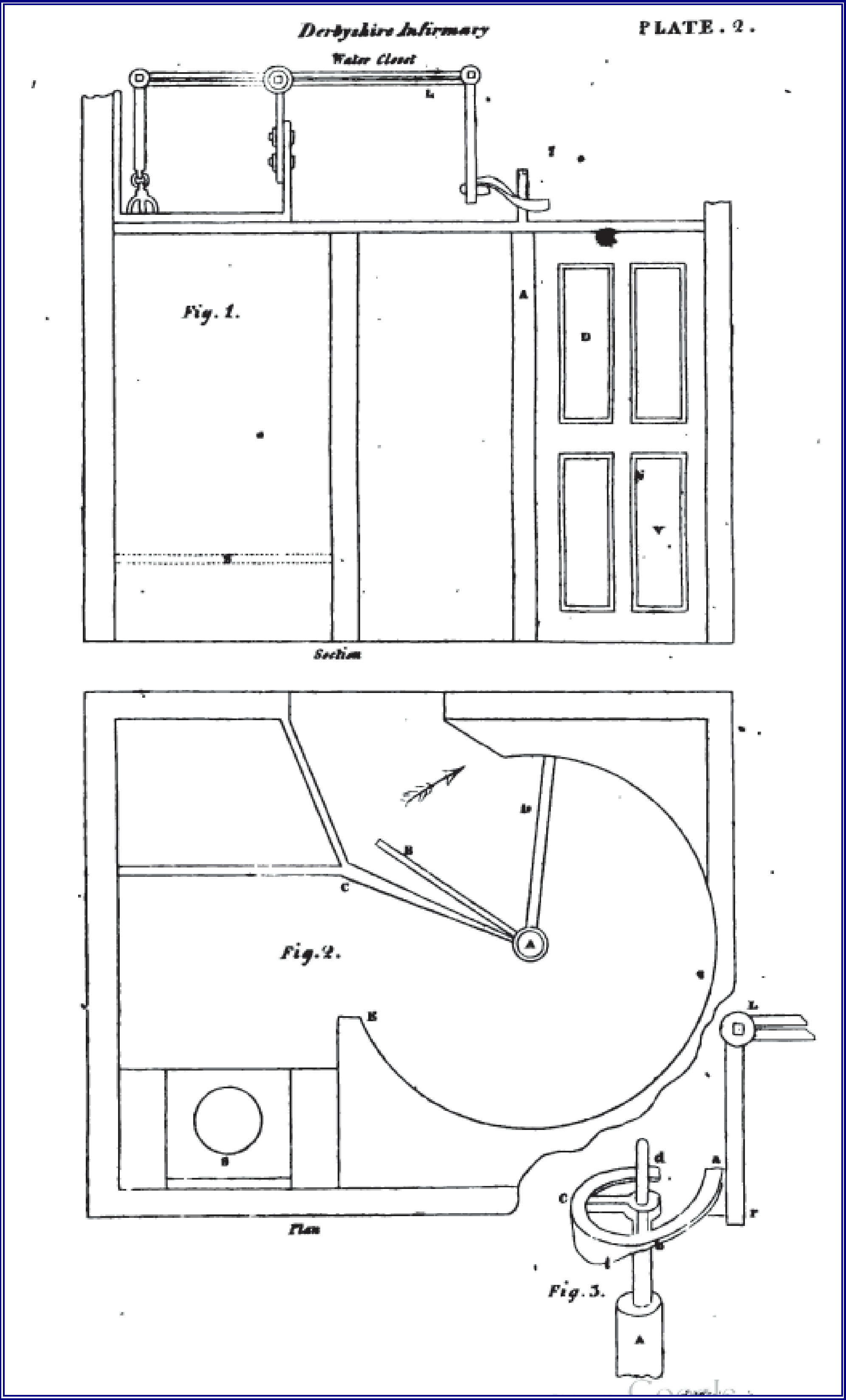


Fig. 1.
Funnel
Hot air Chamber
Cockle
Cold air
Cold air
Fire Place
Hot air Stove
Fig. 2.
C
F
B
D
G
K
L
H
A
E
Warm Water Vessel
Fig. 3.
D
C
A
B
Washing Machine
Fig. 4.
Side View
g
g
Bed for Helpless Patients
Fig. 5.
g
h
Section
Fig. 6.
A
F
K
End View


Derbyshire Infirmary
PLATE. 2.
Water Closet
Fig. 1.
Section
Fig. 2.
Plan
Fig. 3.

to give a general notion of its principal peculiarities in structure and arrangement, referring for minuter particulars to the volume itself, which is enriched with engravings from the hands of Mr Lowry. *

The Infirmary was built or begun during the year 1807. The committee appointed to manage the erection of it had advertised for plans, but none of those sent in were adopted, and the committee themselves at last undertook the task of forming a plan, and caused a model to be prepared accordingly, upon a large scale, which was found of great use during the progress of the work. The conditions pointed out by the advertisements were, that the building should be of stone, that it should contain fever wards, having a separate entrance, as far removed from the principal entrance as possible; that there should be convenient access to every side of the building; that the fever wards should contain twelve beds, and the whole eighty beds at least; and that, besides the usual conveniences of an hospital, it should have two day rooms for convalescent patients.

"The site of the Infirmary is on the south side of the town of Derby, at a short distance from the London road, and the building, from its elegance and magnitude, and the great taste with which its grounds are laid out, has rendered that entrance into the town particularly striking and agreeable. It consists of three stories, the basement story being a little sunk and surrounded by an area, and the middle or principal floor being somewhat elevated, and approached by steps and a portico, supported by four Doric pillars."

The base of the whole approaches to a square, and the edifice itself is nearly of a cubical form, the staircase to the upper story, and a spacious hall, being in the middle of the building. The roof of this central part is drawn up into a conical form, terminating in a dome, containing several windows which completely illuminate the hall, and within it is also an outlet for the escape of foul air, provided with a turncap, and communicating, by means of flues, with every apartment appropriated to the patients. The roof of the surrounding rooms is separated from that of the centre, and, to obviate the evils arising from snow and ice, the gutter which surrounds the

* The letters of reference to the plates are in some instances erroneous or wholly omitted; and we could have wished that the dimensions of the different apartments, as well as *scales* to the plans of apparatus, &c. had been inserted. These may still be added, even without a new edition of the letter-press. The height also of the different stories should be stated.

central part is covered with slates, elevated by wooden slips about two inches square, with a sufficient space also between the ends of the slates, for the water of the melted snow to drain off, an expedient which is found effectually to obviate the necessity of removing the snow.

The first or basement story contains the kitchen, laundry, cold and warm baths, with various domestic offices, and a stove-room on a peculiar construction, by which the whole edifice is supplied with warm air; a steam-engine of two horse power, with a very large boiler, and two spacious public baths, adjoining the vestibule. The second floor is devoted principally to the officers and servants of the establishment; but contains also two wards for sick persons, and six apartments for the reception of fever patients, which, with the corresponding portion of the upper story, are detached from the rest of the building, and have a separate entrance at the back, so as to render the fever department completely insulated. The upper story is devoted exclusively to patients; containing, besides general wards, two large rooms for convalescents, eight smaller apartments, appropriated to acute cases, and an operation room, with two adjoining wards for patients after operation.

The chief peculiarities by which this excellent institution is distinguished are, 1. The arrangements for warming and ventilating the building. 2. The warm-baths. 3. Various contrivances connected with the kitchen. 4. The apparatus for washing, and the laundry. 5. The water-closets.

1. The author's account of the ventilating and warming apparatus is premised by some observations on the general principles of what may be called, in the strictest sense, Domestic Economy; and there are likewise valuable remarks, in other parts of the volume, upon this important subject. He mentions, with just honour, as having taken the lead in this department of inquiry, the names of Franklin and Count Rumford; and complains, with apparent justice, of the great deficiency of architects in general in this department of the knowledge connected with their profession. He gives judicious directions as to the structure of houses, and the choice of situation; and states the superiority of brick over all other materials, as possessing greater durability as well as other advantages. But he dwells with particular approbation on the construction of buildings rendered fire-proof by the substitution of iron for wood; and mentions several examples of large buildings so constructed: among others a mill, erected in 1792, by Mr Strutt of Derby, which was originally 115 feet long by 30 wide, and six stories high, and has since been much enlarged.

"This subject," he adds, "has hitherto received so small a share of attention, that it is probable the historians of the next century may instance our building houses that may be burnt down, as a proof of our little progress in civilization, just as we now do the practice of former times, when houses were warmed by making fires in the middle of the rooms. Were the Derbyshire Infirmary now to be erected, it would probably be done without any wood being used in its construction, and without even iron pillars and beams." p. 8. —"The greatest defect, however, in the construction of dwelling-houses, public buildings, and manufactories, is observable, not so much in the materials of which they are constructed, as in the means of warming and ventilating them. Notwithstanding the boasted comforts of an Englishman's fireside, we see it accompanied with evils which loudly call for remedy. The common construction of fire-places, and the means of admitting air into the rooms, is quite sufficient to convince us that these principles have never been investigated in a philosophical point of view. When a house is built, a tunnel is made from each room, for the escape of smoke and vapour, the greatest part of which ought to be consumed. This is also a channel for the escape of the air of the room, which cannot be replaced, but by the cold air from the atmosphere; for the entrance of which no provision is made, except by the accidental crevices formed by the shrinking of the wood, forming the doors and windows. The evils resulting from these defects are, *first*, those sitting before a good fire are scorched on one side, and chilled by the cold air on the other: *secondly*, the cold air entering the chimney, without passing through the fire, destroys its draughts, and renders the combustion of the fuel so imperfect, that a considerable portion passes away unburned, or comes into the room in the form of smoke, producing the greatest domestic evil. That which goes out of the top of the chimney annoys the neighbourhood; and that which adheres to its sides would soon entirely stop the chimney-funnel, if not removed by means, in the greatest degree degrading to human nature." pp. 8, 9.

The usual structure of kitchens is characterized by the author as equally preposterous and unappropriate; and the mode in which clothes are commonly washed and prepared for use is not less susceptible of improvement. The main objection to all the methods of heating generally in use is, that the *radiant* heat alone is taken advantage of; and the remedy is to render the air itself the vehicle of warmth, a point on which this volume contains a great deal of useful disquisition. It is justly remarked, that a supply of fresh air is necessary to warm-blooded animals, for the purpose of equalizing their temperature as well as for respiration; and the author points out forcibly the advantage to be derived from the steady temperature of the earth itself, in securing this great source of health and domestic comfort.

"At a very little depth below the surface in all countries, the earth is of the average temperature of the climate, as may be ascertained by the temperature of springs. It will hence appear, that, if the air which is requisite to supply a house in the winter of cold countries, were made to pass along a subterraneous cavity, it would become considerably warmed. It has been found by experiment, that a passage of 200 feet in length has had the effect of warming the air of the atmosphere passing through it, to much above the arithmetical mean, between the outer air and that of the earth. Such a provision, aided by the power of two turncaps, (as will presently be shown,) would be the means of increasing the comfort of dwellings in countries where severe long winters are experienced, and the same advantages would apply to the cooling of apartments in hot countries. The air, which is sometimes heated to 100°, might easily be cooled down to 80°, by passing through a tunnel at a considerable depth." pp. 56-7.

The warm air stoves in the Derbyshire Infirmary, and the system of flues for ventilation and heating, connected with them, are constructed on a principle invented by Mr Strutt in the year 1792, and brought to the test of experience by repeated trials in other buildings, before its application to this institution. The structure of the stove, we think, is admirable. It occupies a small room in the basement story of the building, and is supplied with air from below, by a subterraneous channel or culvert communicating with the open air by means of a turncap, the opening of which is always turned towards the wind by a vane; while the turncap on the summit of the building, which may be considered as the opposite extremity of the ventilating tubes, has a contrary direction given to it by similar means. The cold air flue, in the Derbyshire Infirmary, is about four feet square,* its length seventy yards, and when the thermometer in the shade in the outer air stood at 80°; the current, after passing through the flue, was found, where it entered the stove-room, to be 60°, and was of sufficient force to blow out a lighted candle.

The stove, which we shall now briefly describe, is placed near the centre of the building, immediately over the orifice of the

* The section of this flue should be such, as to present the greatest possible internal surface, and should, therefore, be "a long parallelogram, the length at least three times the breadth," and for a corresponding reason, the section of the *hot* air flue should be a circle. Cold air flues should be made of the best conductors of heat, and those for hot air of the worst.

culvert. The detail of its construction requires the illustration of plates; but the section (Plate I. fig. 1.) will probably render its more prominent features sufficiently intelligible. Immediately above the fire-place, there is a hollow cockle, or receiver, made of iron and of large capacity, within which the smoke and vapour of the fuel circulate, before they escape downwards into the chimney. This cockle is surrounded on the outside, at the distance of eight inches, with a casing of brick traversed by numerous openings, each of which is provided with a tube of sheet iron or earthenware, reaching to within three-fourths of an inch of the iron cockle, and serving to bring the outer air into closer contact with its heated surface; * from whence it is conveyed to a large air chamber above, and thence, by an appropriate system of flues, vertical and horizontal, to all parts of the building. The horizontal flues are formed of slates, closely jointed with cement at the corners and ends:—If the flues are to be under ground, and horizontal, they ought to be double, with a space for air between, but if vertical, rolled iron will answer very well. The openings of the flues into the apartments are all provided with registers, which are moveable only by means of a key kept apart for that purpose. The middle story of the building is also traversed vertically, by two funnels, (besides the main flue leading from the warm air stove,) one of which commences on this middle floor, with a sliding door which may be opened to different degrees, and terminates in one of the horizontal hot air flues in the story above. This allows the escape of any excess of hot air not required in the uppermost story, and prevents the stoppage of the current of air which otherwise would very soon allow the cockle to become red hot, and thus to be rapidly destroyed by oxidation. The second funnel opens also at its bottom, in the middle story, and terminating in the roof, ensures the complete ventilation of the hall.

In this arrangement, it is essential that the stove should be placed considerably below the rooms to be warmed, since the author states the velocity of the heated air to be as its temperature, and as the square root of the height; from 15 to 20, or even 30 feet, he considers as desirable, reckoning from the bottom of the air chamber upwards.

Mr Sylvester mentions, as a remarkable fact in the history

* These tubes form a more important part of the contrivance than might at first be imagined. The addition of tubes to a stove, in which, at first, there were only square openings in the partition surrounding the cockle, was found to produce double the effect, from the same quantity of fuel.

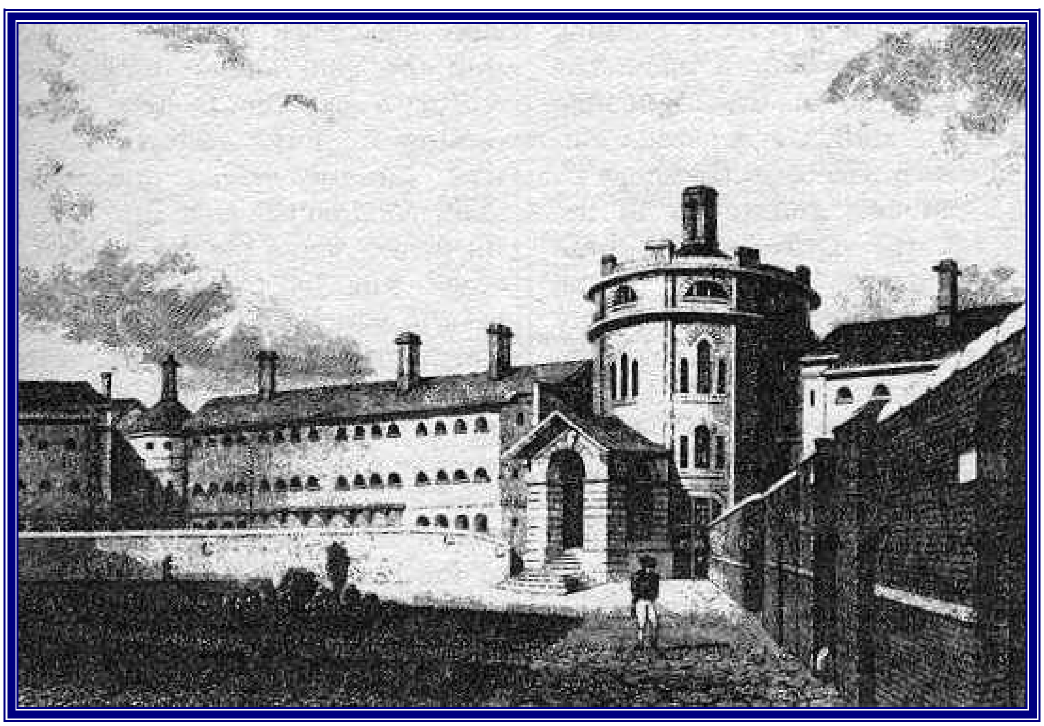
of this invention, that, although it had been used in the cotton-mills of Messrs Strutt and Company, as early as 1792, it never was noticed in any publication. He describes also portable stoves on the same principle, which must be very convenient in private houses, and refers to the Pauper Lunatic Asylum at Wakefield,* the new gaol at Maidstone, the North Staffordshire Infirmary, and the Nottingham Lunatic Asylum, as exemplifying, on a large scale, the success of the plan, although, in some of these instances, the omission of proper flues, in the original construction of the buildings, has prevented its complete efficacy. The church of Leek, in Staffordshire, affords an example of its successful application to places of public worship.

Subjoined to this account is a comparative statement of the effects of the warm air stove, and of those produced by steam, as a vehicle of heat; the facts upon the latter subject are taken from the work of Mr Buchanan, and the author deduces from his calculations, that, with equal quantities of fuel, the stove has the advantage, in the proportion of more than six to one. This great superiority, arising in part from the difference between the specific heat of air and water, but principally, perhaps, from the much greater loss of temperature in the conveyance of steam than in that of warm air, and the great quantity of heat, which, of necessity, passes off in the hot water, and in uncondensed steam.

2. *The Baths.*—Besides the baths on a small scale, for the use of the patients in the Infirmary, there are, as already stated, two of large dimensions, situate near the main entrance of the building, and accessible to the public; which produce a considerable revenue to the charity. They are both warmed by steam, and are kept constantly, one at a temperature of 84°, the other at 92°. The extent of each is an area of 162 square feet at the bottom, and the content is 810 cubic feet, or 4860 gallons of water. A small stream of cold water is constantly running into them during the day, and they are heated by means of a steam pipe, one inch in diameter, from the boiler of the steam-engine, which terminates in a larger pipe of cast-iron four inches in diameter, carried quite round the bottom of the bath, and concealed in a recess of the wall, which is covered by

* In this institution, "when the stoves are in full action, the air, on the average, moves with the velocity of five feet in a second: the area of each of the main flues is 12 feet, which gives 120 cubic feet for the quantity which passes through the house in every second, and, supposing the whole cubic contents to be 400,000 cubic feet, the whole of the air will be changed in a little less than every hour." p. 59.

Pauper Lunatic Asylum, Wakefield



Maidstone Gaol

LOUIS CHARLES ABEL TELLIER
1828-1913

The French "Father of Cold"

[82] Louis Charles Abel TELLIER **1828-1913**

Known in his native France as "Père du Froid" (Father of Cold), Tellier had a life-long interest in refrigeration and its application to brewing and food storage. He made a methyl ethyl compressor (1868). The same year, he failed in his attempt to ship refrigerated meat to London aboard the *City of Rio de Janiero*. At Auteuil, near Paris, he established what was possibly the first mechanically refrigerated cold storage plant. He disputed the priority of F. Carré's [81] absorption patent, but his own machine was unsuccessful. The ship *Frigorifique*, equipped with a Tellier system, successfully transported chilled meat from Rouen to Beunos Aires (1876). Though honored by the Académie des Sciences (1911), he died in relative poverty.

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

TELLIER Louis Charles Abel (1828-1913)

Born in Amiens, France. Died in Paris.

Son of a grocer, later established as a spinning mill owner at Condé-sur-Noireau.

Charles Tellier, endowed with a very fruitful inventive mind, was interested in refrigeration from 1867. In 1868, he made a methyl ether compressor. The first examples of this were installed in the Menier chocolate factory, near Paris, and in a brewery in New Orleans, U.S.A. In 1868 also he installed the machine on the "City of Rio de Janeiro" to try to transport meat across the Atlantic (this failed because of machinery breakdown). At Auteuil, near Paris, he set up a refrigeration workshop in which he experimented on the action of cold on various foodstuffs (these experiments were checked by a commission of the Académie des Sciences in 1873).

In 1876, the ship "Le Frigorifique", equipped by Tellier with methyl ether machines, succeeded in transporting chilled meat from Rouen to Buenos Ayres, and to do the same on the return voyage.

A tireless worker, Tellier did much to draw the attention of scientists and industrialists, worldwide, to the possibilities opened by artificial refrigeration. From 1867, he wrote many books relating to refrigerating techniques: on ammonia in industry (1867), cooling in breweries, thermodynamics of refrigeration, production of ice, storage of meat and other foodstuffs, etc. He received a prize from the Académie des Sciences in 1911.

Tellier was also interested in a wide range of subjects, especially in watergas engines, in compressed air, in tarring of roads, manufacture of fertiliser by drying of sewage.

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

Charles Tellier, the French "Father of Cold" (Figure 8-20), constructed a vapor-compression machine using methyl ether as early as 1868. In that year, he attempted to ship refrigerated meat to London aboard the *City of Rio de Janeiro*; however, his ether refrigerating equipment failed, and the meat spoiled. Undaunted, Tellier next established a plant to produce ice and "carafes frappées" (frozen bottles) in Marseilles in 1869 (Figure 8-21). This venture was not a commercial success. Tellier next built what is possibly the first mechanically refrigerated cold storage plant in the world in Auteuil. This venture also failed due to the outbreak of the Franco-German war in 1870.[50] Tellier continued to promote his refrigeration ideas, which were unique in that he used forced refrigerated air as a cooling means (Figure 8-22). Tellier successfully demonstrated the system in 1879, when he refitted an English packet-boat, renaming it *Le Frigorifique*, and transported a shipload of meat and poultry chilled to 0_C from France to South America (Figure 8-23). The return trip was not as successful in keeping the meat and Tellier did not pursue commercializing the idea.[51] Although he was active in refrigeration research for most of the rest of his life and despite all his contributions to the advance of refrigeration, he died in relative poverty in 1913.[52]

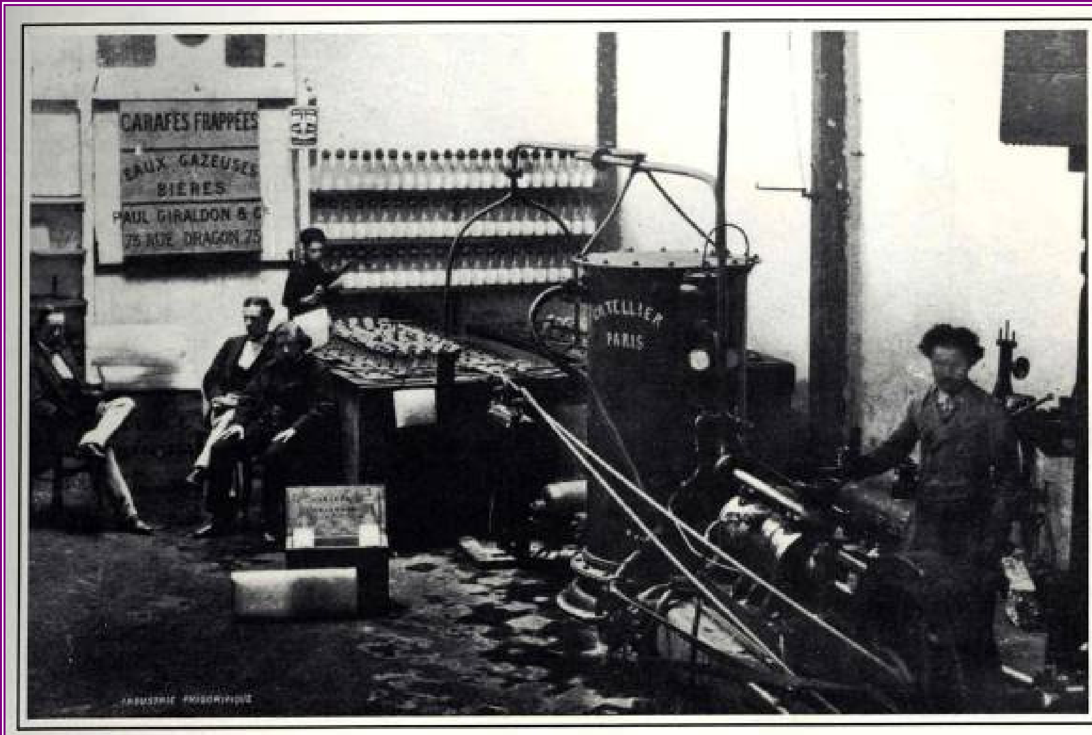


Figure 8-21 *Refrigeration plant built and operated by Charles Tellier in 1869 at Marseilles using methyl ether refrigerant. Charles Tellier is seated to the right of two unnamed Americans who came to France to purchase the plant in 1870. Tellier later said, ". . . sometime after that, they left. But a short time after they arrived in their country, the 1870 War broke out. One of the two was of German origin. Naturally, I didn't see him anymore. The other person died at this instant. Thus ended the business, so well begun, and this photograph was the only profit I got out of it" (from:* Compte Rendu Officiel De La Manifestation . . ., *1913).*

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