13 GOLDEN OLDIES

The standard lead pipe used by the Romans was probably the first major example of engineering product standardisation. The pipes were made in 3 m lengths from cast sheets formed in a strip 100 mm wide. A sheet was wrapped around a wooden mandrel and welded by pouring molten lead along the butted joints. The Romans also used a number of pipe fittings and junctions. They were also aware of the possibility of lead poisoning.

Lead continued beyond the Industrial Revolution when iron tubing was made from wrought iron strip which was folded around a mandrel with an overlap that was afterwards forge-welded while hot. Copper tubes were made in a similar way, using brass to braze the joint.

Copper pipe is recorded as being first used for domestic water services in 1810. In 1838, Charles Green patented a process for making solid drawn brass or copper tubes. In 1850, heavy gauge copper tubes with screw threads came into use at hospitals and similar institutions, a practice which continued until about 1910 when light gauge tube was introduced with fine thread or rubber ring jointing.

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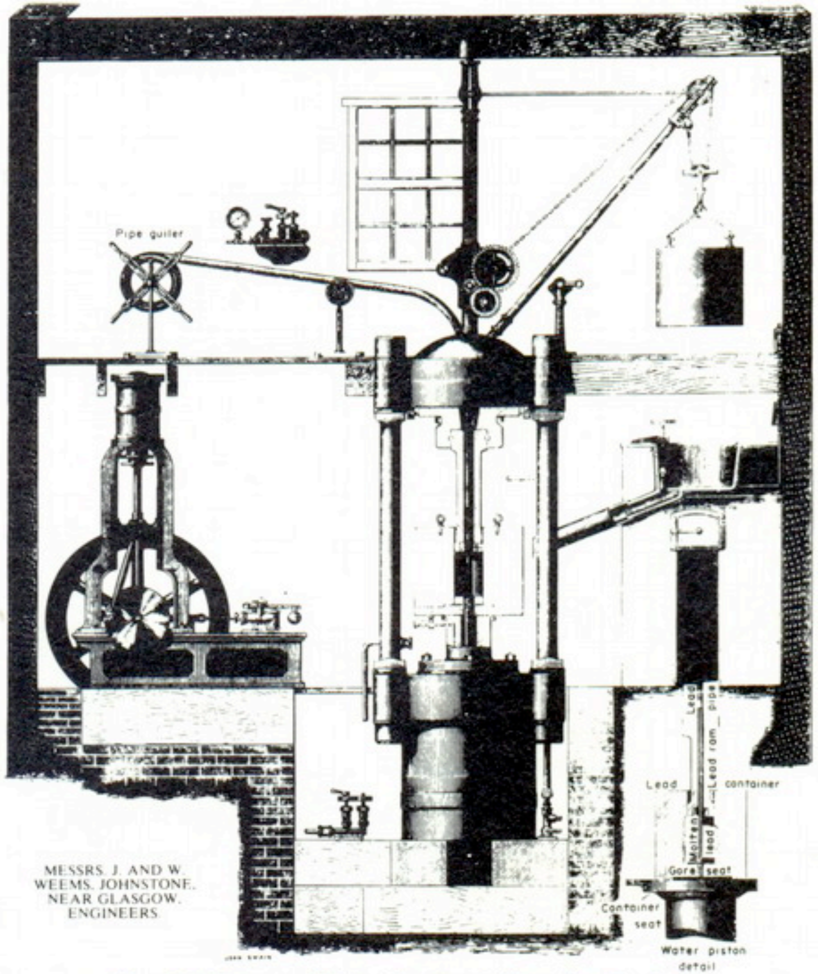

An 1883 machine for making lead pipe.

14 GOLDEN OLDIES

Fire brigades can be traced back to the Roman Empire though there may have been similar organisations in China (4000 BC) and Egypt (2000 BC).

Throughout the Middle Ages, London and other great cities were regularly devastated by fire. The situation improved with the development of the fire engine in the early 16th century and the formation of fire brigades in the 17th century. Little thought was given to providing buildings with their own permanent means of fire fighting, other than a leather bucket.

Since waiting for the brigade to arrive was not a recommended pastime, inventors developed mechanical contrivances intended to provide escape. John Lescale's automatic fire escape of 1878 was on wheels and intended to be kept in the house as a piece of furniture and moved to the window in the event of fire, the escaping occupant descending from an upper storey by means of a rope and pulley.

Some of the fire escapes were downright dangerous. The "parachute fire escape" of 1879 had "overshoes having elastic bottom pads of suitable thickness to take up the concussion with the ground."

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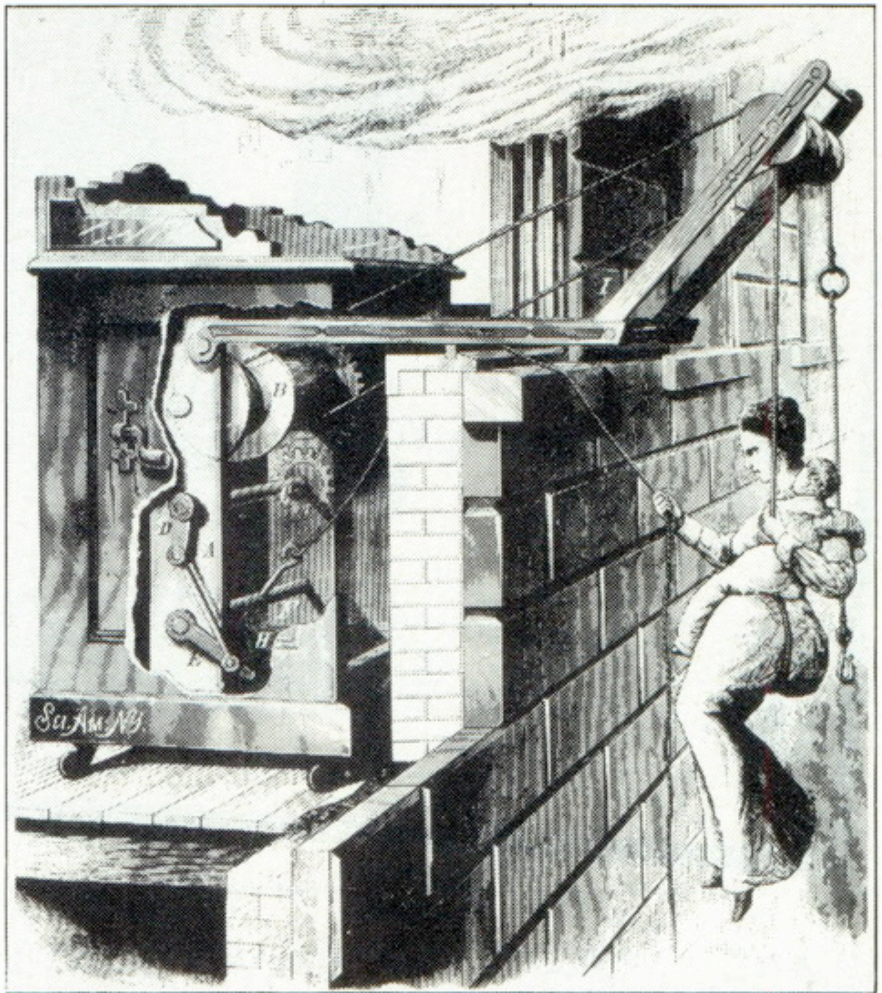


John Lescale's automatic fire escape of 1878.

16 GOLDEN OLDIES

The word "thermostat" was coined by Dr Ure in 1830, though temperature-sensitive devices had been in use for more than a century prior to this.

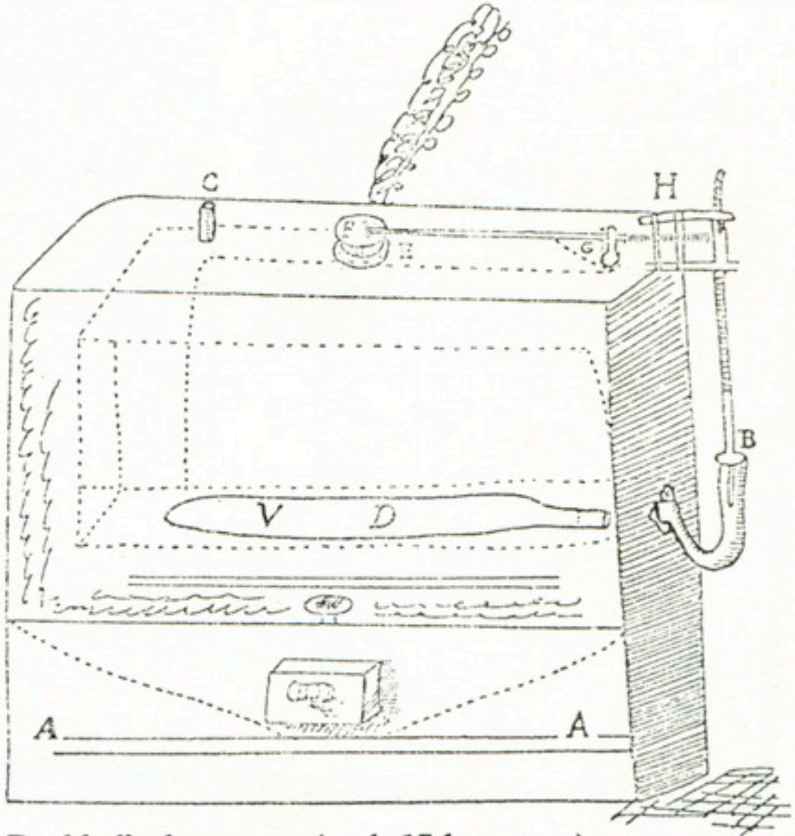
The prototype thermostat is probably that invented early in the 17th century by Cornelius Drebbel, a Dutch engineer, as is illustrated in the diagram.

According to Francis Bacon, Drebbel devised his temperature regulator only incidentally, "as an instrument to serve another purpose: alchemy. He believed he could transmute base metals to gold if he could keep the temperature of the process metal constant for a long time."

"Drebbel's apparatus consisted basically of a box with a fire at the bottom and above this an inner compartment containing air or alcohol with a U-shaped neck topped by mercury.

As the temperature in the box rose, the increased pressure of the heated air or alcohol vapour pushed up the mercury level, which in turn pushed up a rod; this mechanical force was applied to close a damper and accordingly throttle down the fire. Conversely, if the temperature in the box fell below the desired level, the gas pressure was reduced, the mercury dropped and the mechanical linkage opened the damper".

This regulator seems to have worked quite successfully, for Members of the Royal Society in London, including Robert Boyle, Christopher Wren and in the following generation Robert Hooke, showed a considerable amount of interest in it.



Drebbel's thermostat (early 17th century).

Contributed by the CIBSE Heritage Goup.

15 GOLDEN OLDIES

Cooling by ice and snow has been known for thousands of years in places as far apart as China and ancient Egypt. By the 1880s the consumption of natural ice in New York had reached the amazing rate of 660 kg/person per year.

Wooden sheds for the storage of ice were provided on the banks of the Hudson River "having double walls insulated by a layer of air, which is a poor conductor of heat. Each of these provides storage for some 50 000 to 100 000 tons of ice."

Harvesting of ice was a major industry and numerous specialised tools were developed for ice cutting and handling, including Sager's steam driven machine (illustrated) of 1883 for sawing ice into small blocks of suitable dimensions.

Although commercial refrigeration was by now practicable on a commercial scale, many people were unconvinced as to its future: "Ice machines, however they may be improved and their effect increased, will never in the more northern parts of the temperate zone acquire importance enough to match the demand for natural ice, even approximately."

A few years after this was written, the natural ice trade was being seriously eroded and shortly after the turn of the century it was almost completely lost.

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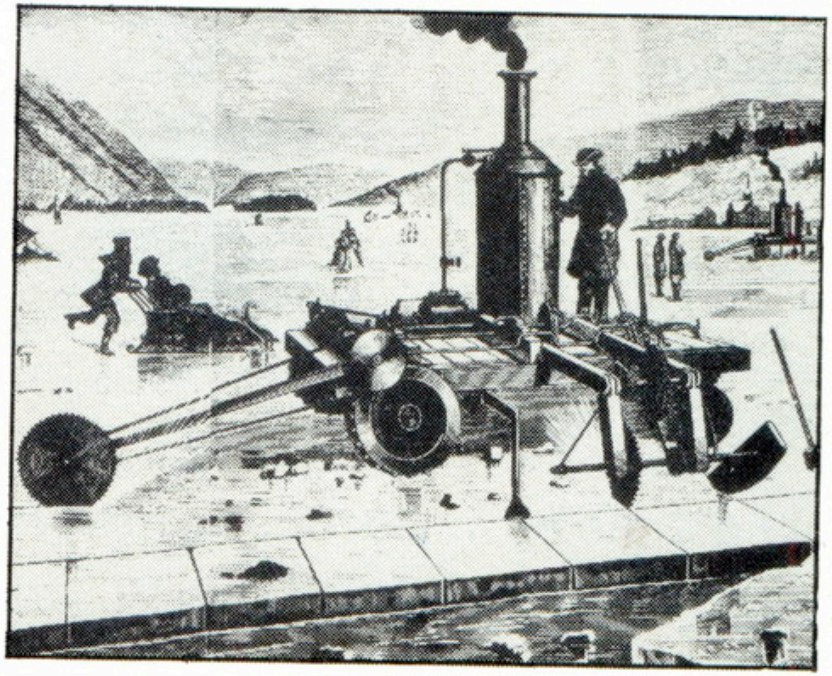

17 GOLDEN OLDIES

An early air conditioning system, said to be due to John Vallance, was a plenum scheme, devised in the early 1800s. The room was made airtight, with only a revolving door and an aperture in the ceiling, to which a pipe was fixed and carried through the roof and inverted into a few inches of water. Air was pumped into the room, passing through pipes in a tank filled with cold water when the room was to be cooled, or with hot water if heating were needed. The pressure of the incoming air caused vitiated air to be exhausted through the pipe in the ceiling, and the water "valve", by ensuring a positive pressure in the room, ensured freedom from draughts through the door or window cracks.

In 1838, Dr D B Reid took the next step when his House of Commons plant included a spray chamber, shown in the illustration, and a crude filter to remove soot particles from the incoming fresh air.

He proposed further treatment of the air for special purposes including additives such as nitrous and nitric acids, chlorine, sulphurous, carbonic, ammonia, prussic, acetic, arsenical, mercurial, alcoholic, ethereal, benzonic, camphor, lavender, orange, cinnamon, creosote! Some ten years later, he suggested that artesian well water should be circulated through the air heating pipes in order to cool the Commons in summer.

Joseph Lister followed Reid's idea of medicating the air when in 1869, he sprayed a watery solution of carbolic acid into the air of theatres. This later led him to develop antiseptic practices in hospitals.

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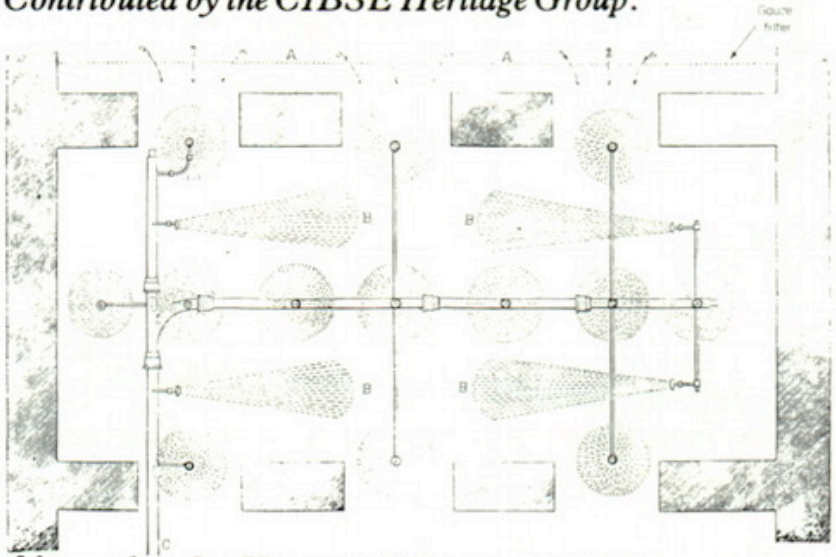


Air washer for House of Commons (1838).

GOLDEN OLDIES

The method of using underground tunnels to evaporatively cool air for use in buildings was revived by the British Army in India during the 19th Century. A Dr Jeffreys' proposed to use underground tunnels to ventilate soldiers' barracks in India, shown in the diagram.

"We may view the uppermost 50 feet of the earth's surface as one vast equalising reservoir, ready to absorb a large proportion of summer heat. If we adopt proper measures for cooling thoroughly in the winter this mass of earth, we may have it brought down nearly to the winter mean before the ensuing hot season, ready to absorb again much more heat than when it had to cool itself by the tardy spontaneous upward conduction through its whole mass."

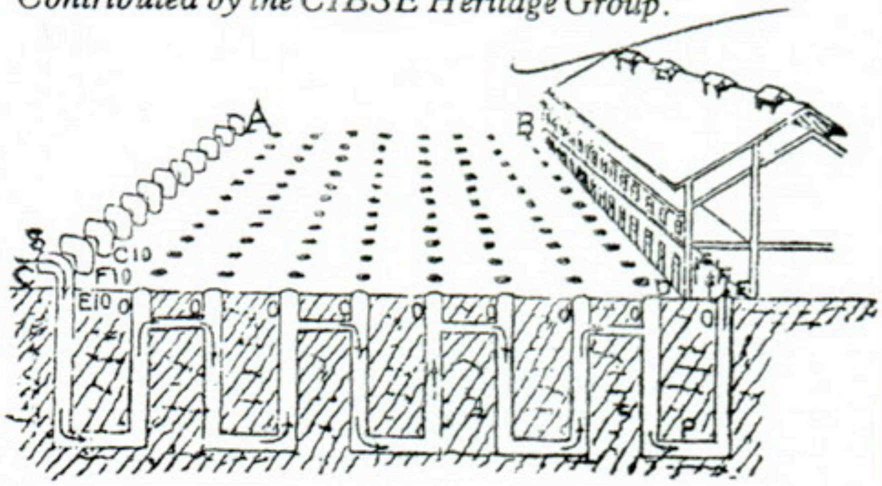
Dr Jeffreys' plan required a plot of ground 120 × 80 m with some 200 wells dug all over at around 7 m intervals; an easy task in those days for "the cost of digging them all will be only £20".

There is no record of Dr Jeffreys' "refrigerator-well ventilation" having been a success.

In 1876 John Wilkinson described how to ventilate and cool a dairy by means of a 60 m long subterranean duct; an idea for which he was granted a "sub-earth ventilation" patent in 1879.

In 1879 a patent was also granted to Morrill A Shephard, "for an improvement in producing heat and ventilation by sinking wells or shafts to reach water-bearing stratum, in which are to be laid pipes through which the air supply for the building is to be drawn."

Contributed by the CIBSE Heritage Group.



Dr Jeffreys' earth cooling system (India, 1858).

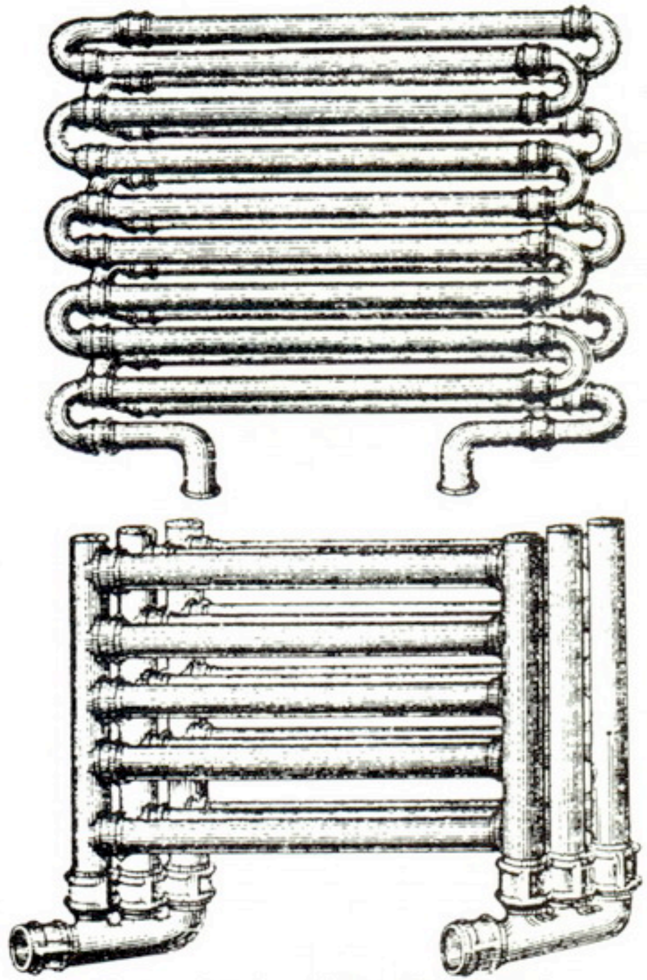
19 GOLDEN OLDIES

The use of hot water or steam for space heating necessitated the development of an appropriate heat exchanger. In his early attempts, James Watt used a box 1·07 m long, 0·76 m wide and 25 mm deep of tin plates. (We know now that this radiator of 1784 did not emit sufficient heat because of its bright metallic surface). Sir John Leslie found, in 1801, that the application of a coat of pigment to a metallic surface nearly doubled the discharge of heat.

Erroneous ideas were still current some years later, for it was supposed by some that pipes of tinplate or copper would (because of their thinness) emit heat more rapidly than iron.

The early forms of room heating surface in common use consisted of cast or wrought iron pipe. 4-in (1000 mm) pipe was so extensively used that it became a standard of reference for design — heat requirements were expressed in "ft of 4-in pipe", as were the outputs of boilers and other appliances. It continued in use well into the 20th century, in spite of the development of other, more compact, forms of heating surface.

The first alternative was the cast-iron coil, made by connecting short lengths of pipe by means of 180° bends. Next followed the box-end coil, the lengths of pipe being fixed into box-like vertical headers. The small-diameter pipe coil was suitable only for steam; the larger box coil was suitable for both water and steam. The unprepossessing appearance of such "coils" led to the use of decorated cases in cast iron (and so eventually to the natural draught convector).



Contributed by the CIBSE Heritage Group.

Above: **Return-bend and box-coils for heating.**

GOLDEN OLDIES

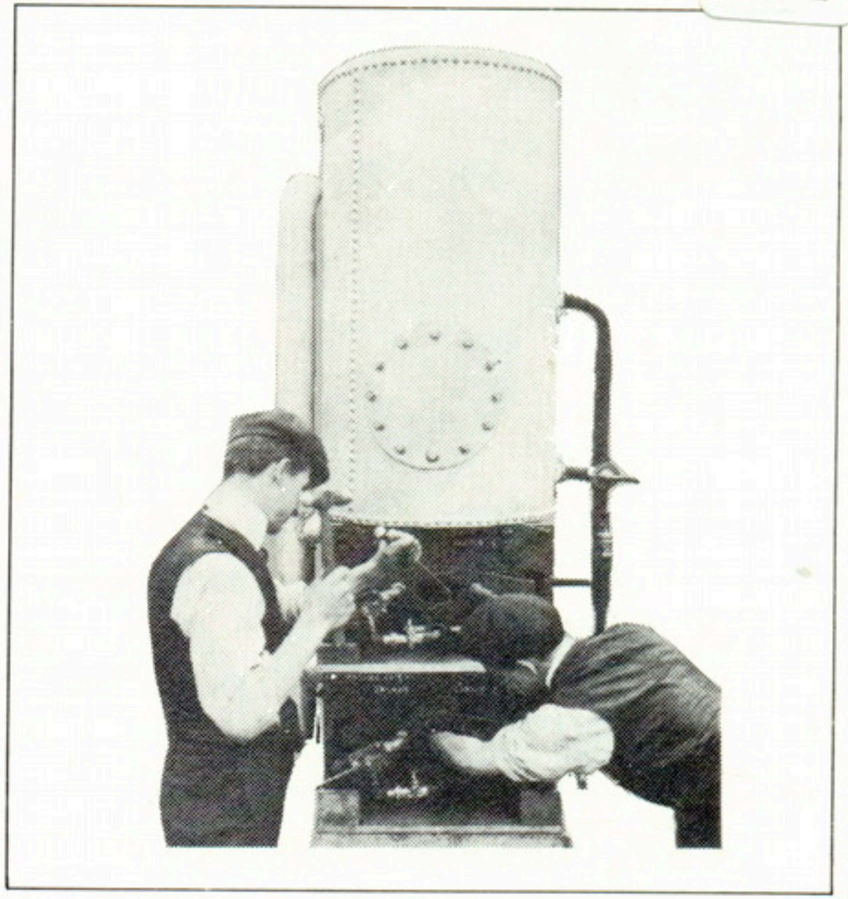
In place of our usual Golden Oldie this month we have an appeal. The Heritage Group needs more "software"; ie, catalogues, textbooks, old photographs etc of building services.

The history of building services is not nearly as well documented as many other industries and yet as the regular Golden Oldies show, the industry has a rich and often amusing history. If you have, or know the whereabouts of any material relating to building services; from its earliest days right through to the 1940s and beyond, that either has no home or which could be better safeguarded, please let the CIBSE know.

Very often, the historical value of old documents is not realised. Some of the items in the Heritage Group's collection have turned out to be among the last surviving records of certain pieces of equipment in practices. Even pieces of equipment designed as recently as the 1940s can prove difficult to identify. Only if a good archives source of such information can be steadily built up will future engineers be able to understand and to feel sympathy towards the industry's past.

If you can help phone or write to Mrs D Rowe, Secretary to the Heritage Group, CIBSE, Delta House, 222 Balham High Road, London, SW12 9BS, telephone 01-675 5211.

By the way, the photograph is headed "a Potterton boiler servicing demonstration 1905." With a cold chisel and hammer?!



The address cast into the boiler is "Balham, London." Building services roots in Balham obviously go back a long way.

Contributed by the CIBSE Heritage Group.

GOLDEN OLDIES

What are believed to have been "candle-makers' instruments" were unearthed from the ruins of Herculaneum (destroyed in 79 AD) and a fragment of a candle-like device discovered near Avignon has been attributed to the 1st century AD.

In the 4th century, Constantine the Great is said to have illuminated Byzantium on Christmas Eve with lamps and wax candles.

What is probably the oldest picture of a candle is shown in a 7th century miniature in the Bibliotheque Nationale, while other candles are shown in the *Exultet Roll* painted in the 11th century. Another picture of this period, illustrating the ceremony of ordination to the priesthood, shows a short taper on a tall ceremonial candlestick, though in 10th century Church terminology the word "candela" (now the SI unit of luminous intensity) meant a lamp.

Tallow candles became fairly common in England about the end of the 12th century. They demanded frequent attention, for they melted rapidly and were prone to smoke horribly. Beeswax was harder, cleaner and longer lasting; but it was more expensive and only used by the rich and in churches. The poor used rush lights.

It is believed that footlights (candles) were first used on the English stage in the 17th century. By comparison, a 17th century drawing of a German stage depicts candles used in hanging chandeliers.

A 17th century German stage, with wings, backcloth and hanging chandeliers.

Contributed by the CIBSE Heritage Group.

GOLDEN OLDIES 24

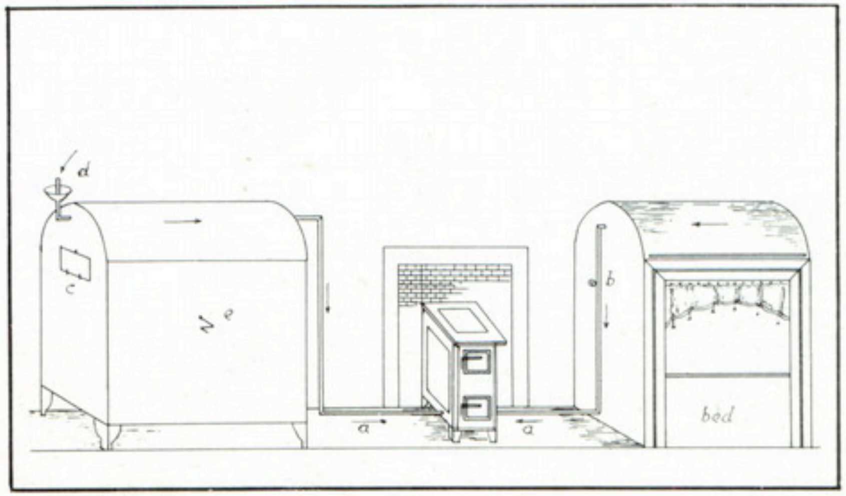
In 1831, a Mr Fleming of Glasgow proposed a system of ventilation for hospitals, in which an aspirating chimney was used to draw air from the top or back of the beds by means of tubes.

"The plan was first tried in a large and densely peopled house which had long been remarkable as a focus of fever infection. In the last months of 1831, the total cases of typhus were 57. In was then that Mr Fleming was allowed by the proprietor to apply his ventilating process. There were only four instances of fever in the house from the beginning of 1832 till December 1840. It is impossible to doubt that the change from extreme unhealthiness to the reverse is mainly owing to the ventilating apparatus — for no other condition has been changed".

Mr Fleming also made a prototype of a ventilated hospital bed.

"Air tubes *a a*, branch off from the base of the stove and terminate, one in the roof of the bed, the other in the top of the washing apparatus. In the washing apparatus there is a plash-wheel, of which *e* is the handle; while *d* is a filler for the admission of air and water. Infected clothes are put in by the door *c*, a sufficient quantity of boiling water is poured in by the filler. The plash-wheel is now set in motion for as long as is necessary. During this process, the air to support combustion in the stove being supplied through the filler, passes through the washing box and carries infectious matter generated by a patient in the bed is in like manner carried off and destroyed in the fire.

Contributed by the CIBSE Heritage Group.



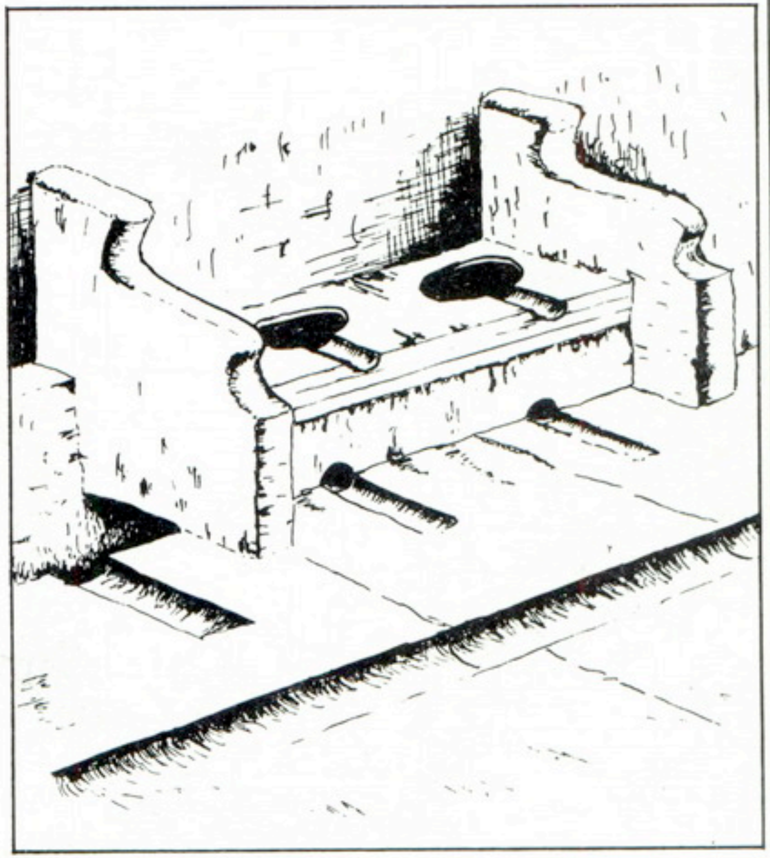
Mr Fleming's ventilated bed and washing machine (circa 1840).

GOLDEN OLDIES

Archaeological evidence indicates that water supply and drainage systems existed in many of the ancient civilisations. Toilet facilities existed in the palaces and some private dwellings, in Assyria, Babylon, Greece and Crete. The toilets comprised a stone or wood seat on pillars, built over a drainage channel or water course. At Knossos, it is possible that the toilet was flushed with water after use. Babylon had many public as well as private toilets. 4000 year old dwellings in the Indus Valley provide evidence of latrines and water-borne sewage.

In ancient Rome, sanitation reached a peak of development. In the earlier days of both Greece and Rome, rooms were set aside as toilets and portable vessels were used. Later, in Rome, the richer people had closets with water cleansing, sometimes from a flushing tank, operated by a tap. Many public toilets and urinals were provided, for the use of which a charge was made. At the centre of the Roman town of Timgad in North Africa lay the Forum, and off to one side, the public lavatory containing rows of stone seats sometimes separated by arms carved as dolphins, but otherwise public in the truest sense of the word.

An obsessive preoccupation with sanitation may have even contributed to the downfall of the Roman Empire according to Rolleston (1751):
"— we may date the commencement of (its) ruin from the introduction of gold and silver chamber pot and close stool pans".



Public toilet at Timgad (Algeria).

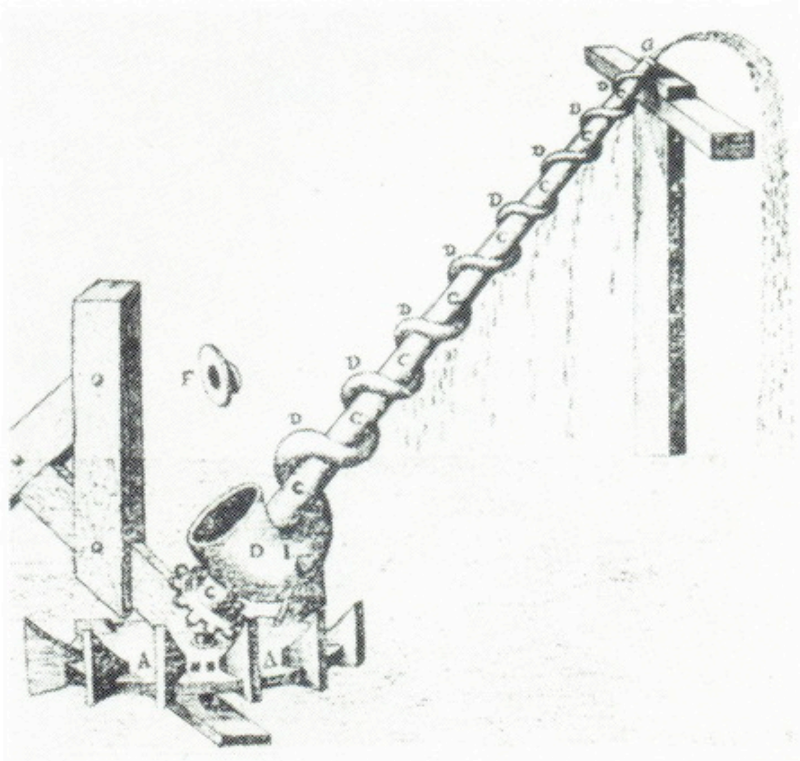
Contributed by the CIBSE Heritage Group.

GOLDEN OLDIES

Primitive methods of raising water from one level to another relied on the use of a bucket, or various forms of the well sweep (swape) — an early application of the lever. These were intermittent methods, but later it was possible to raise water continuously by the screw or snell, commonly ascribed to Archimedes (287-212 BC). The Archimedean water screw, in is simplest form, consists of a coil or pipe that is rotated with its axis slightly inclined to the horizontal while the lower end is below water level.

The chain of pots, or Persian wheel, had a horizontal axis and carried a rope chain to which earthenware pots were attached at regular intervals. A similar device, the square pallet chain pump, was used in China in the 1st century AD. Its Western prototype, the "chain and rag" pump, did not appear until about the 15th century. In these pumps, one side of the chain passed up through a vertical conduit and the water was drawn up the conduit by the pallets or rags sealing it as they entered at the bottom.

The first pump using a piston and cylinder combination may have been the fire pump described in Hero's *Spiritalia* around the 2nd century BC, but force pumps were also used for domestic purposes, of which the best known is probably the Ctesebian suction and force pump (1st century BC). Roman plunger pumps were discovered at Silchester and the British Museum has similar bronze pumps found at Etruria and Bolsena.



Archimedes' spiral screw (c. 230 BC).

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