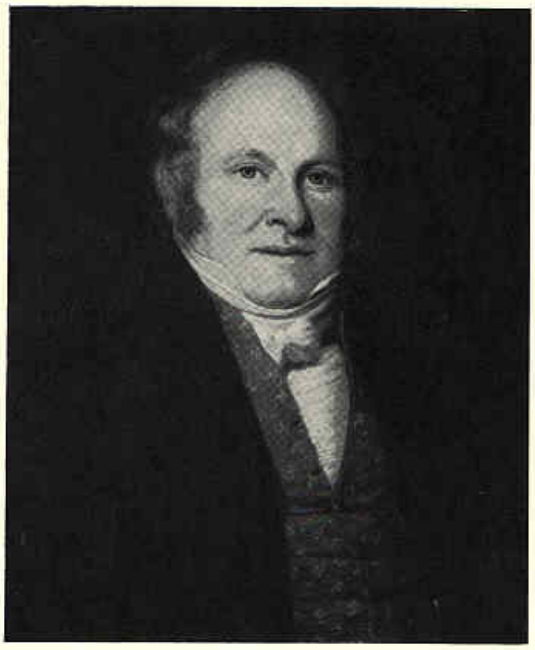
G.N. HADEN & SONS LTD

ACTIVITIES

This brochure is undated but clues in the text suggest it was published in the later 1940s.



GEORGE HADEN, M.Inst.C.E.

1788 – 1855

'FOUNDED 1816'

In the proceedings of the Institution of Civil Engineers for the year 1856-7, there appears a memoir of GEORGE HADEN, written by Sir Charles Manby, M.Inst.C.E., F.R.S, the Secretary of the Institution. From this memoir are drawn the following excerpts, which give a vivid picture of the founder of the Company and of its earliest days.

'Mr George Haden was born at Handsworth, near Birmingham, on the 23rd of July, 1788 . . . He was apprenticed to Messrs Boulton and Watt, of Soho, in whose service his father (who is honourably named in Mr James Watt's will as an "honest man") had been for many years employed, chiefly in the superintendence of the copying-machine business . . . On the completion of his apprenticeship he was employed by the firm, first at Manchester, whence he was sent for as "the young man that was never tired"; and for them he also erected the first gas-works established in Leeds. He afterwards went to Glasgow for the same firm, where he remained five years, engaged in erecting the Cranston Hill Waterworks, since removed, being the first in Glasgow. He was also engaged in erecting the first pair of engines that worked together, at right angles, on board a steamboat, the *Princess Charlotte*, on the Clyde. They were two 4 h.p. engines and were intended to work each paddle separately, but Mr Haden connected them . . . One incident will serve to show the active and persevering character of the man. On being sent for to repair an engine, fifteen miles from Glasgow, he rode over, on horseback, in a storm of sleet and snow. He at once took out the piston, when he found a leak in the bottom of the cylinder and as the cylinder was too hot to stand in, he was suspended for twenty minutes, head downwards, repaired the leak, started the engine and returned immediately to Glasgow.

'On his return to England, he settled at Trowbridge and was appointed, by Messrs Boulton and Watt, their agent in the West of England, including the counties of Gloucestershire, Wiltshire and Somersetshire, where he erected a great number of steam-engines for the cloth manufactories. This engagement continued for thirty-four years and after its expiration, he continued to practise on his own account, taking out patents, for improvements in the machinery for the manufacture of cloth . . . During this period his attention was drawn

to the ventilating and warming of buildings of all kinds, a department of the profession which he followed with great assiduity and in which he gained a good reputation, being entrusted with many large buildings in all parts of the country . . .

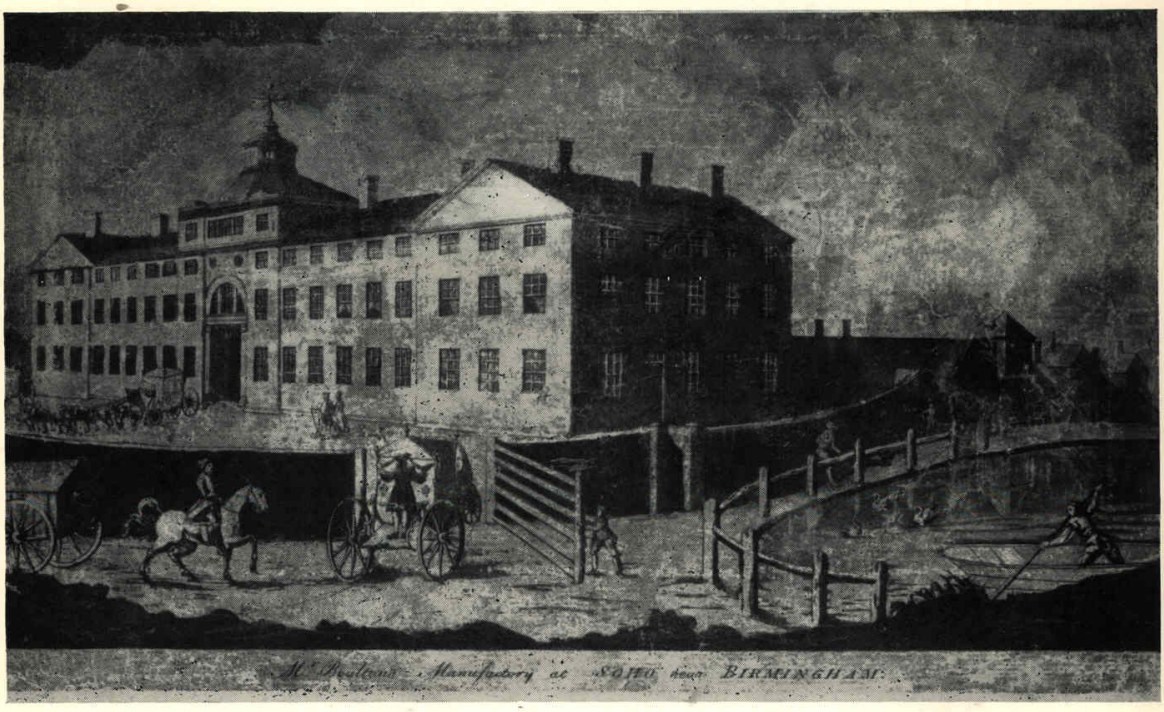
'The local *Advertiser*, in alluding to his death, says: "In the decease of Mr Haden, science has lost an able engineer, society a useful member and the poor a generous and sympathizing friend. Independently of the benefits he afforded the town from the number of men employed and the production of skill he sent all over the globe, he was always ready to lend a helping hand to any good work . . . He was religious without sectarian bigotry—liberal without ostentation."

'He had been a Member of the Institution of Civil Engineers for twenty-two years, having joined it in 1834.'

So the Company was born in the very womb of mechanical engineering. Yet within a few years it became the pioneer of a new industry. George Haden and his brother James seem to have been infected by the inventive and practical genius of Watt, for while George built engines and invented new machinery for the cloth trade, James patented a ventilating warm air stove and installed the first in Matthew Boulton's house in 1819.

Later in that century, groups of large buildings were heated by steam and hot water from one boiler house. Later still, exploiting the new electric motor, the firm developed a water screw, a precursor of the centrifugal pump, and its single installations were soon serving a square mile.

In this century development is more rapid; waste heat from electrical generation is used, industrial drying is accelerated and controlled, radiant heating is introduced and air conditioning comes into its own. As our engineers interpret the work of the physiologists and physicists, calculation replaces the rule of thumb, the true conditions for health and comfort emerge and methods for control are developed. At last we practise a science.



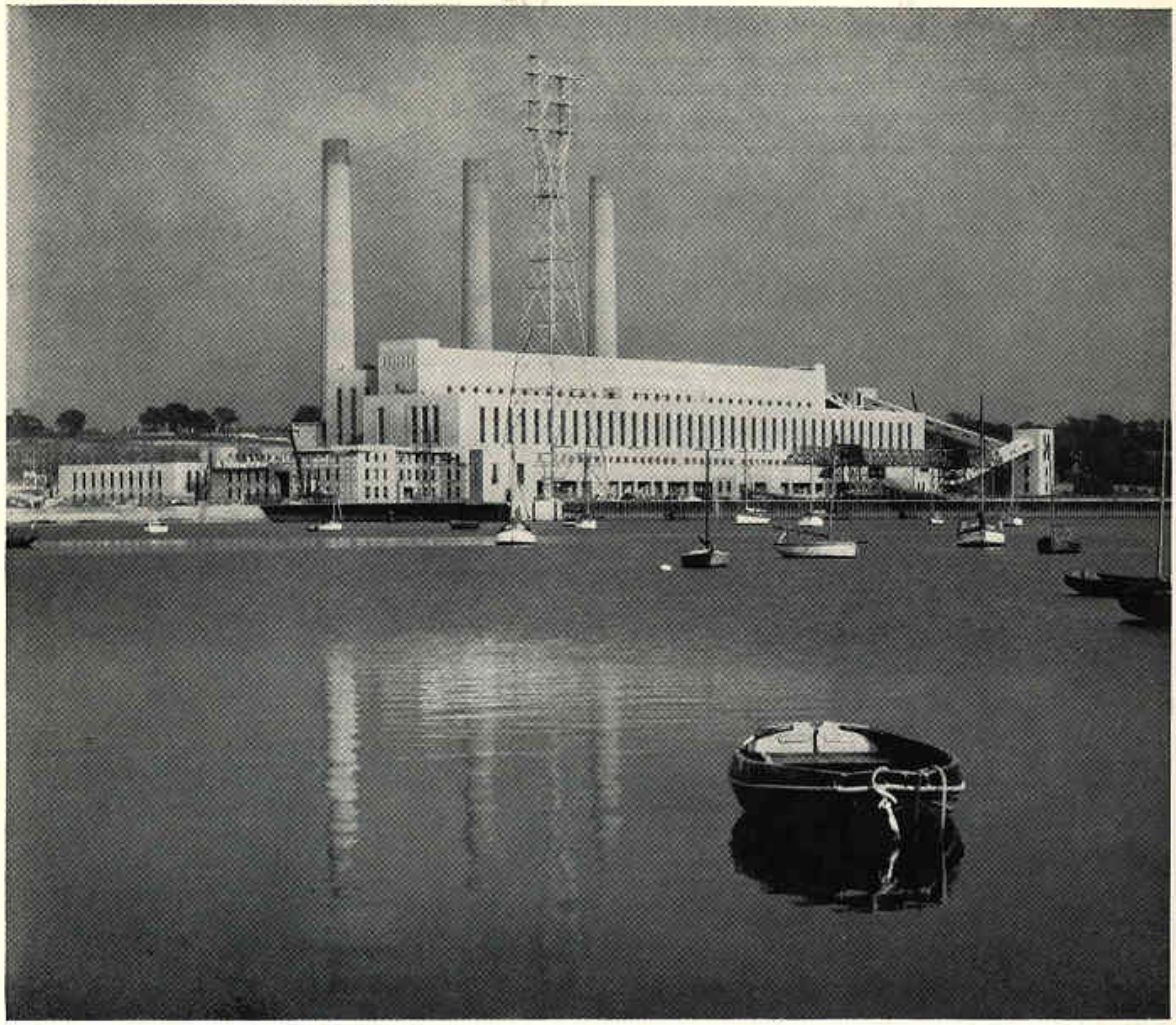
The building pictured is the Soho Woks in Birmingham of Boulton & Watt and not Haden's Trowbridge Works as has been suggested elsewhere

ACTIVITIES

The aim of this booklet is to give some impression of the wide range of activity covered by the Company under the direction of the fourth generation of Hadens—from the warming of Buckingham Palace to the temperature control of machine tools vital to British production.

WRITTEN BY ERIC KEOWN

SKETCHES BY RUSSELL BROCKBANK



CLIFF QUAY POWER STATION

IPSWICH

When the Victorians designed a building you could tell all too plainly what it was for. One of the favourite jokes of modern architecture is to lead us astray. Abattoirs now look like luxury cinemas, hotels like factories. This idyllic-seeming pile might be guessed to house a sub-committee of U.N.O., or a town council in Scandinavia, but in fact it is the Cliff Quay Power Station. Our contribution was to warm the offices, a necessity which even power stations are powerless to resist.

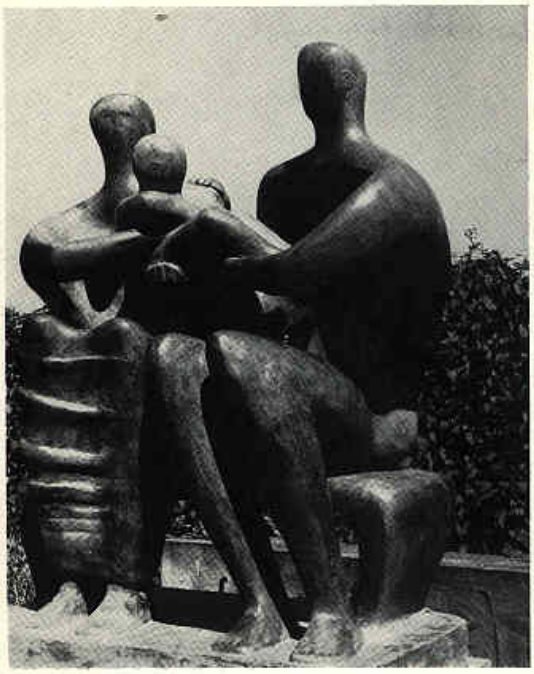
BARCLAY SECONDARY

MODERN SCHOOL

STEVENAGE

It is quite bad enough to be educated, without being frozen in the process. The traditional arrangement in which the master sat by a roaring stove while his victims congealed in the offing is now discountenanced as an unhealthy example of privilege, and from the splendid new State schools now going up the chilblain has at last been scientifically expelled. Light, fresh air and reliable heating are high on the architects' agenda. At the Barclay Secondary Modern School at Stevenage the pupils' imaginations are kept at an even temperature by Henry Moore's thoughtful study of prospective parents picnicking in the nude, while we have looked after more material needs.

Concealed heating panels in the floors of the class-rooms remove at least one excuse for inattention. Steel panels in the ceiling of the gymnasium encourage the queue for the horse. Thermostats with a sharp eye on the weather, alert for its irresponsibilities, control the working temperature of the heating system during the school day. But even among thermostats there is a hierarchy, for on cold mornings king thermostats take over from their junior colleagues to ensure a quick boost of temperature in the classrooms, in time for early lessons. Having seen that their orders are carried out, these dictators can relapse with a clear conscience into a masterly inactivity for which every schoolboy must envy them.



C. A. PARSONS & CO. LTD.

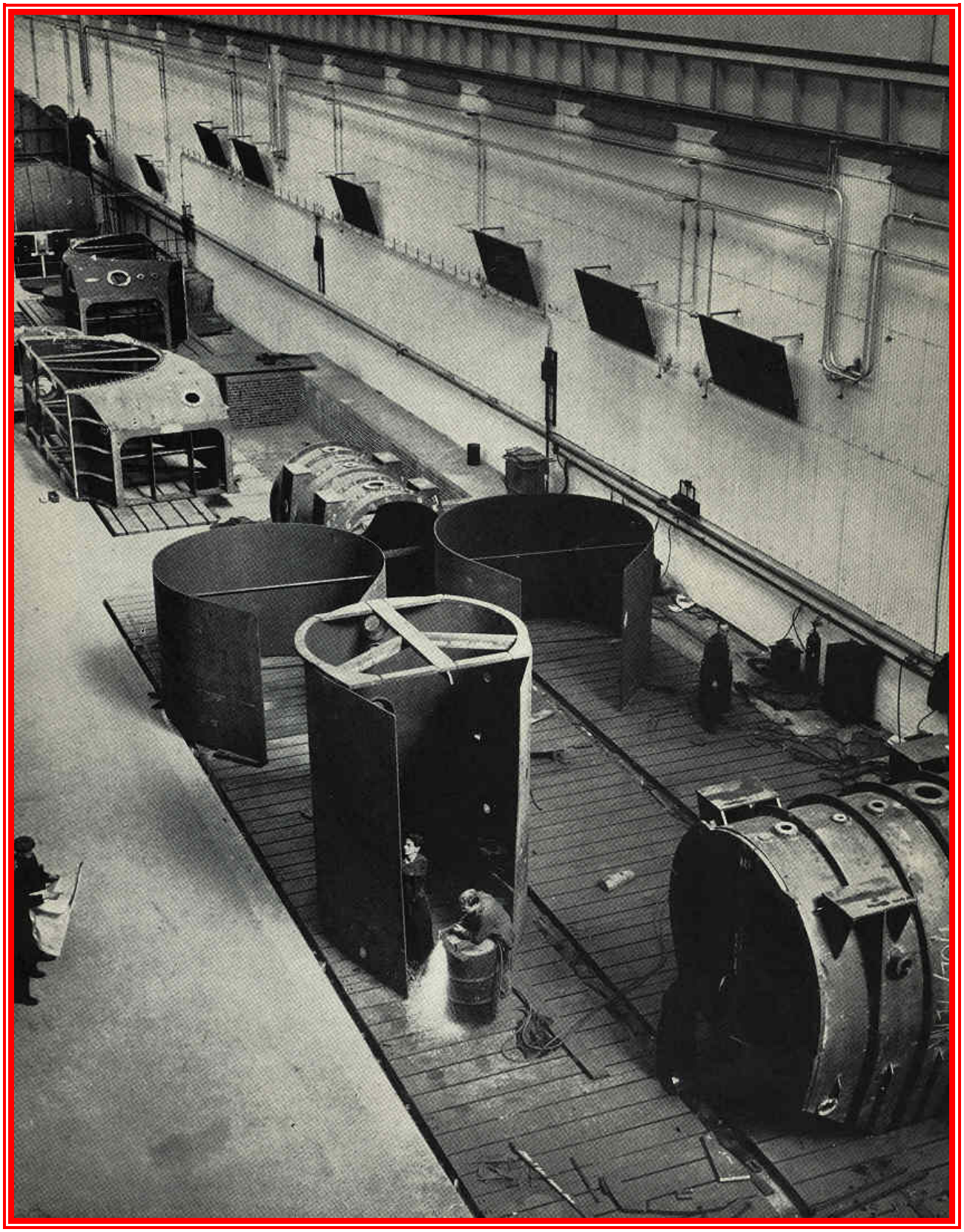
NEWCASTLE-UPON-TYNE

One of the hardest nuts we can be asked to crack is the giant workshop in heavy industry, that is often of hangar construction and has large doors in constant use. Victorian owners of such leaky monsters were apt to expect their men to do decent work in semi-Arctic conditions, but today the masters' attitude is fortunately very different. The shop we illustrate is part of the works at Newcastle-upon-Tyne where that great engineer, Sir Charles Parsons, developed the steam turbine. It is 380 feet long, 200 feet wide, and about 50 feet high; and its walls are of thin sheeting, so that as a retainer of heat it was a poor starter. Being new, however, its problems could be tackled from the ground floor.

We advised our clients to line the roof and outside walls with pressed wood-fibre insulating board, which reduced the heating load considerably, and also the tendency for unwanted cold air to find its way into the building. As with Liverpool Cathedral, which we mention later, we concentrated on designing a system which would warm the occupied lower parts to a comfortable degree without raising the temperature aloft to a ruinous extent; and so we installed high temperature heating panels, some of which you can see in the photograph. These panels were sited so as to direct radiant heat at the men and their machines. It was like fixing a galaxy of small suns where they could help most.

As a result of this arrangement the working portions of the building feel pleasantly warm, in spite of an air temperature some five degrees lower than would normally be thought necessary, while the temperature up above is still cooler. If you contrast the principle of the more orthodox method of convection heating, which can only produce comfortable air temperatures at floor level at the cost of extravagant roof temperatures—15 to 20 degrees higher—you will understand why the fuel bills for the system we describe can be reduced by as much as 20 per cent. And with 4,000,000 cubic feet of space in one shop alone this is more than a bagatelle.

At present this system operates with steam, and its output can be regulated automatically, by varying the steam pressure; but it was designed so that at a later date the panels could be fed with high temperature hot water.

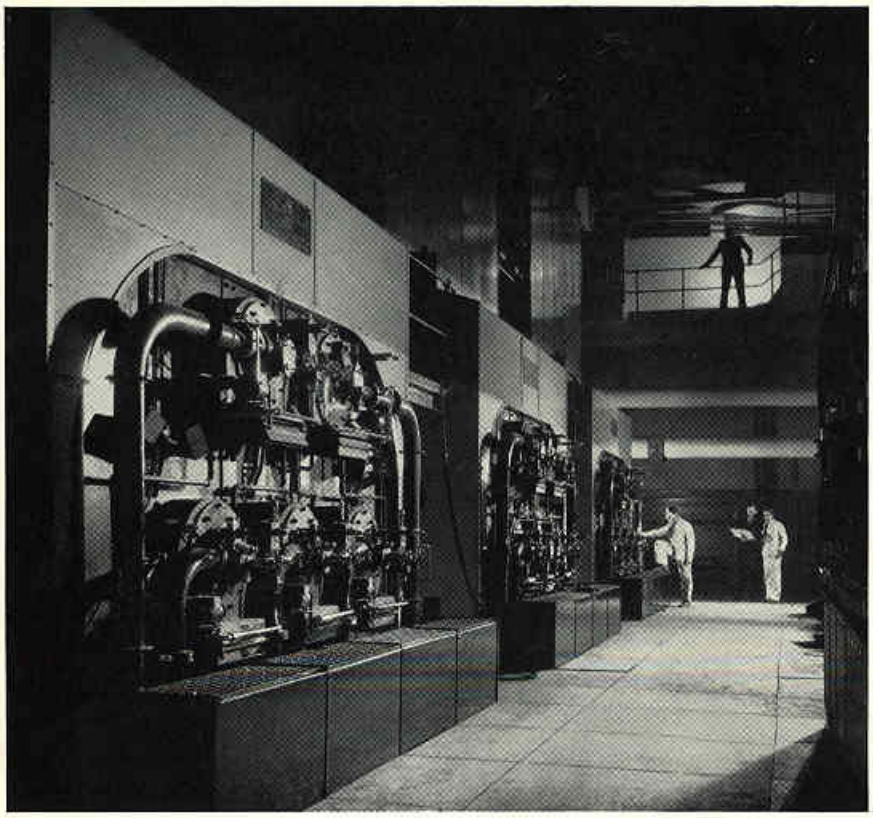


C A Parsons, Newcastle-upon-Tyne

NEW GOVERNMENT OFFICES, WHITEHALL GARDENS

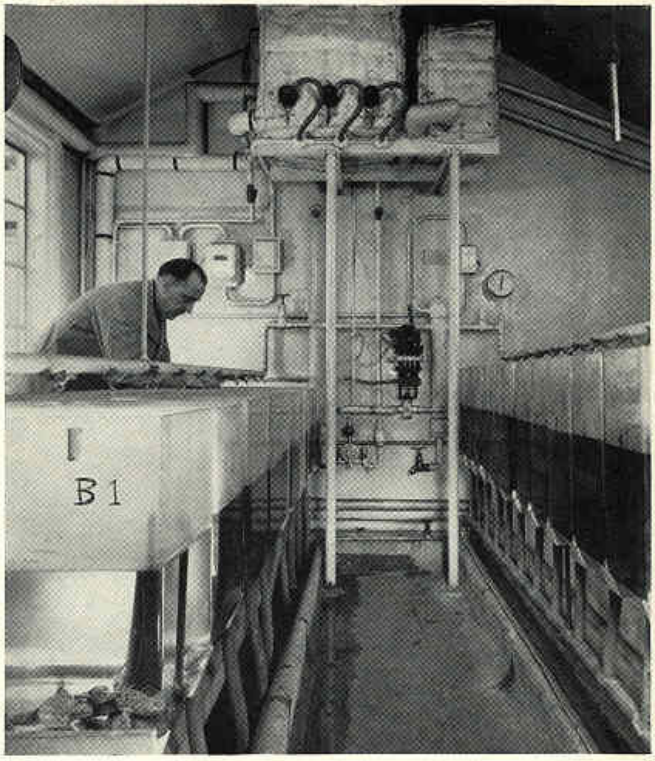
Just before the First World War we suggested a Bill be drafted for Parliament seeking permission to heat the Palace of Westminster, the Abbey and the great buildings of Whitehall from one power station; but the Great War and its aftermath diverted attention from this early idea of district heating.

Today, beneath the new Government Offices in Whitehall Gardens, the Ministry of Works has placed a vast boiler house with three La Mont high pressure hot water boilers. Already, and in addition to the many Ministries we have warmed in Whitehall Gardens, we have connected these boilers to the War Office, the Q.M.G. building, the Ministry of Agriculture and Fisheries and the Royal United Services Institution. But there is room for three more boilers and some day they may heat all the Ministries in Whitehall, and perhaps any new ones which future Governments in their infinite wisdom may conceive. If you put hot water under pressure, its temperature can be raised far above its usual boiling point; and the higher you raise its temperature the easier it is to limit the quantity of water that need be circulated to supply a given amount of heat. The great advantage of this satisfactory principle is that smaller pipes can be used for the trunk mains, and when you are planning in terms of such a prodigious site the saving is obviously worth while.



Groups of pumps at the central boiler house in Whitehall Gardens circulate water at high pressure and temperature to chambers at strategic points in this and other buildings, where the heat is transferred in heat-exchangers to low temperature circuits supplying ventilating air heaters and invisible warming coils or 'panels' concealed in the ceilings. It is these which generate an atmosphere sympathetic not only to the sharpening of blue pencils and an unswerving regard for the faithful completion of the appropriate form, but to the shaping of Government policy. Yet to obtain an even warmth in so immense a building presents special problems. The sun, for instance, may be doing a natural job on thousands of square yards of it, while equally large areas are in shade. For this reason there are eight separate heating zones, with their own circuits controlled by weather compensators on different faces of the building.

Statisticians will be glad to know that the present boilers have a capacity of 72,000,000 B.T.U./hr. and that we used over 60 miles of pipe.



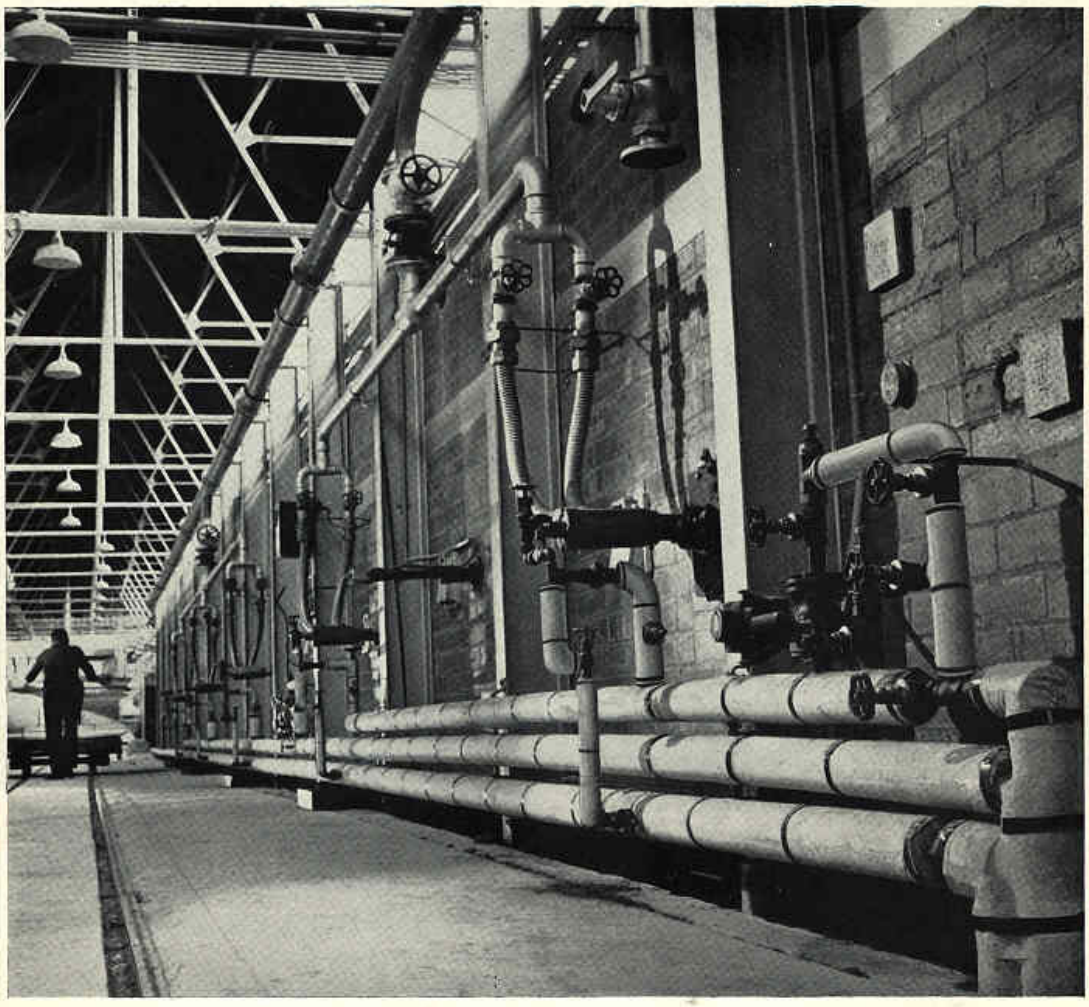
ROYAL PORTSMOUTH HOSPITAL

In *The Wind in the Willows*, if you remember, Kenneth Grahame gave Mr Toad cap, gaiters, an enormous overcoat and gauntleted gloves to keep him warm. As the Pathological Department of the Royal Portsmouth Hospital was anxious to make a closer study of the residents of its new Toad Hall than such equipment would permit, it asked us to make them cosy in a state of nature. This is the kind of delicate new problem which the heating engineer is constantly finding on his plate. We had to discover in a hurry about the private life of the toad, for if these distinguished specimens at Portsmouth were to give of their best to medicine their lightest whim had to be gravely considered.

The official apartments put at their disposal consist of a series of small glass tanks, each containing three or four occupants. One can imagine Mr Toad saying to Ratty—'Come in, my dear fellow, and see my water-conditioned house; it's the latest thing.' Badger and Mole and Rat would look in vain for the armchairs and other bachelor comforts they associated with their friend, but it is pleasing to be able to report that the toads have expressed their satisfaction at their new arrangements by throwing themselves heart and soul into the National Health Service.

SHANKS & CO. LTD., BARRHEAD

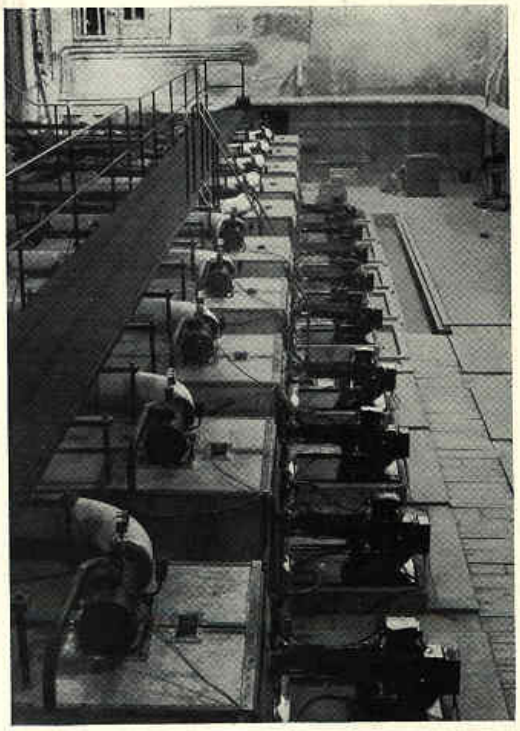
Late in his life Arnold Bennett was delighted when someone shouted across Sloane Street, 'Why, if it isn't the big pot from the Potteries!' Bennett was fired by ambition to write as well as the French novelists, but nowadays big pots are fired most economically in large kilns heated with a mixture of oil fuel and air. Here you see the oil and air feed-pipes running outside such a kiln, 400 feet long, at the Shanks Works at Barrhead. The Gibbons burners serving the kiln are unique in this country in being designed to fire longitudinally, a technique previously used only in the United States.



PALACE OF JUSTICE, TEHERAN

PALACE OF FINANCE

TEHERAN



At Ankara, the modern capital of Turkey where the new Parliament buildings are nearly ready, the Turkish Government wanted the most effective and modern system of air conditioning and heating for this great building high in the hills, where the summers are hot and the winters very cold. So they invited sixteen firms in Europe and America to submit their designs to an international panel of distinguished consultants from England, America and Switzerland—and our designs were placed first. The air conditioning and panel warming installation is one of the largest we have planned, and its installation is now nearing completion.

Just before the War we were given the order for air conditioning, heating, oil fired boiler plant, water services and plumbing at the Palace of Justice, Teheran, the second largest building in Persia. The War began, only local labour was available, and repeatedly bits and pieces en route went to the bottom of the Mediterranean. But to maintain our country's prestige we carried on, and when the Allies moved into Persia in 1941 we took over from Skoda—a great firm then in enemy hands—most of their German sub-contracts, for electrical installations, telephones, and—appropriately in a Palace of Justice—the mortuary equipment.

At the Palace of Finance, an even larger building, we have designed similar services and shipped the materials. Only lack of Government finance prevents completion.

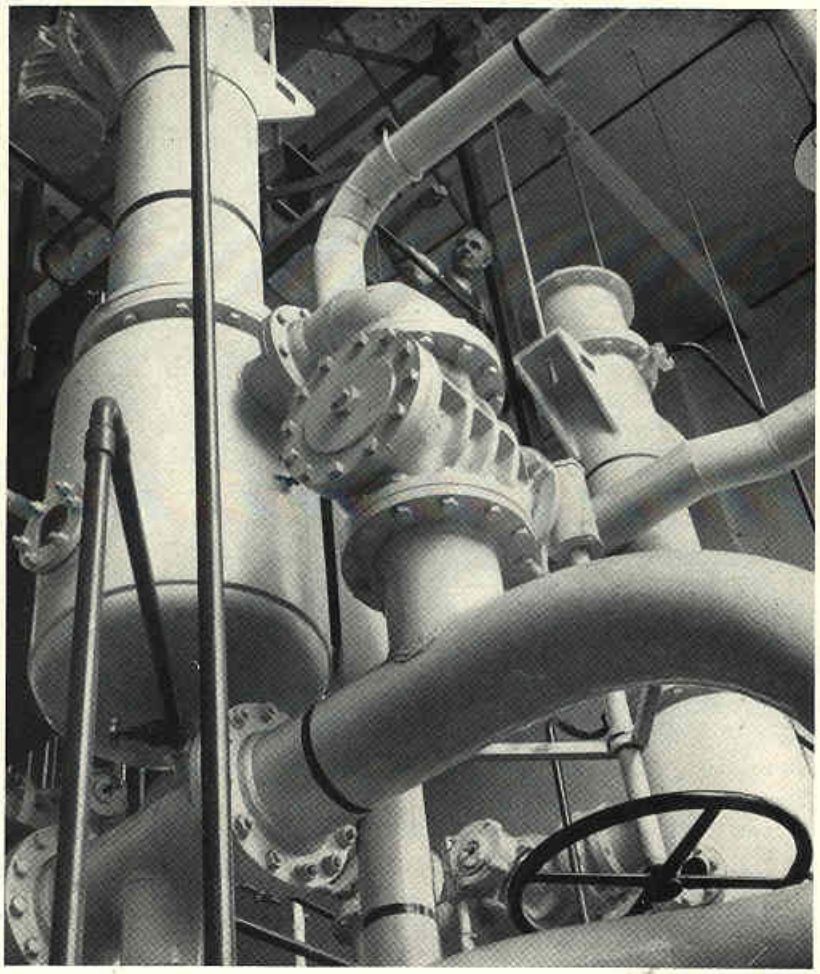
Our foreign ventures have taken us to all of B.O.A.C.'s six continents except the Americas and Australia, and into varying climates.

Among recent installations for air conditioning and other services are the fine new railway station at Baghdad, hospitals at Alexandria and at Kumasi in the Gold Coast, offices for the High Commissioner at Delhi; even in the Antarctic we have provided a heating system for a whaling station on South Georgia Island.

BRITISH THOMSON-HOUSTON CO. LTD., RUGBY

Botanists know very little about the heavy electric plant, but we have had to learn a good deal. Our installations at the B.T.H. Works at Rugby have been designed to assist its cultivation through the whole dramatic range of its growth—from the drying of the largest transformers ever shipped from this country to the processing of resin for insulating material.

In all this fascinating variety one problem was particularly interesting—the control of the atmospheric environment of machine tools to obtain greater accuracy. These are already unbelievably precise, but it was found that even higher standards could be reached when operating in completely stable atmospheric conditions



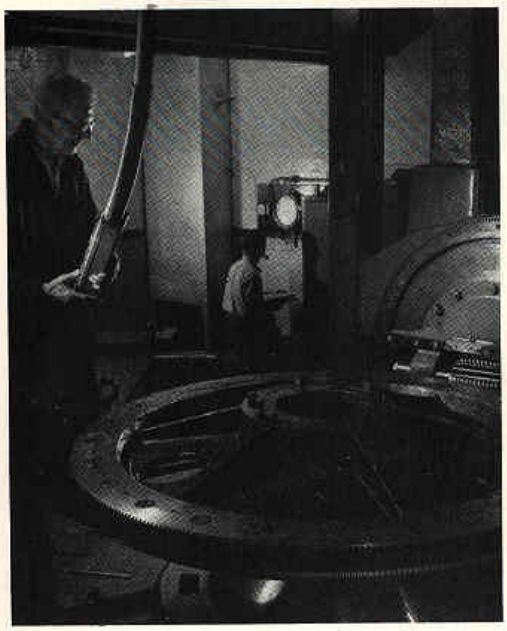
LEFT: *Part of Vacuum of Pipework Installation*

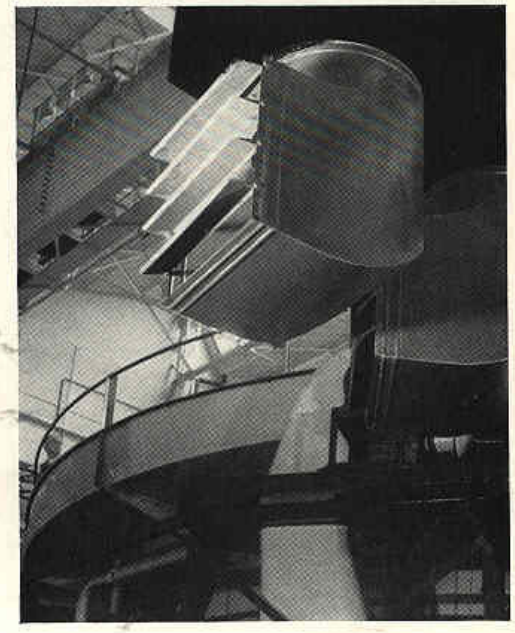
The double-headed hobbing machine in the photograph, for instance, can perform the miracle of turning out a helical reduction gear 10 feet in diameter to within, plus or minus, 60 millionths of an inch. It stands by itself in an insulated cubicle—there are three of these magic boxes in the factory—in which filtered air of controlled humidity and temperature is circulated. Continuous readings are taken by a thermograph and any minute variation in either humidity or temperature sets off a system of visual and audible alarms.

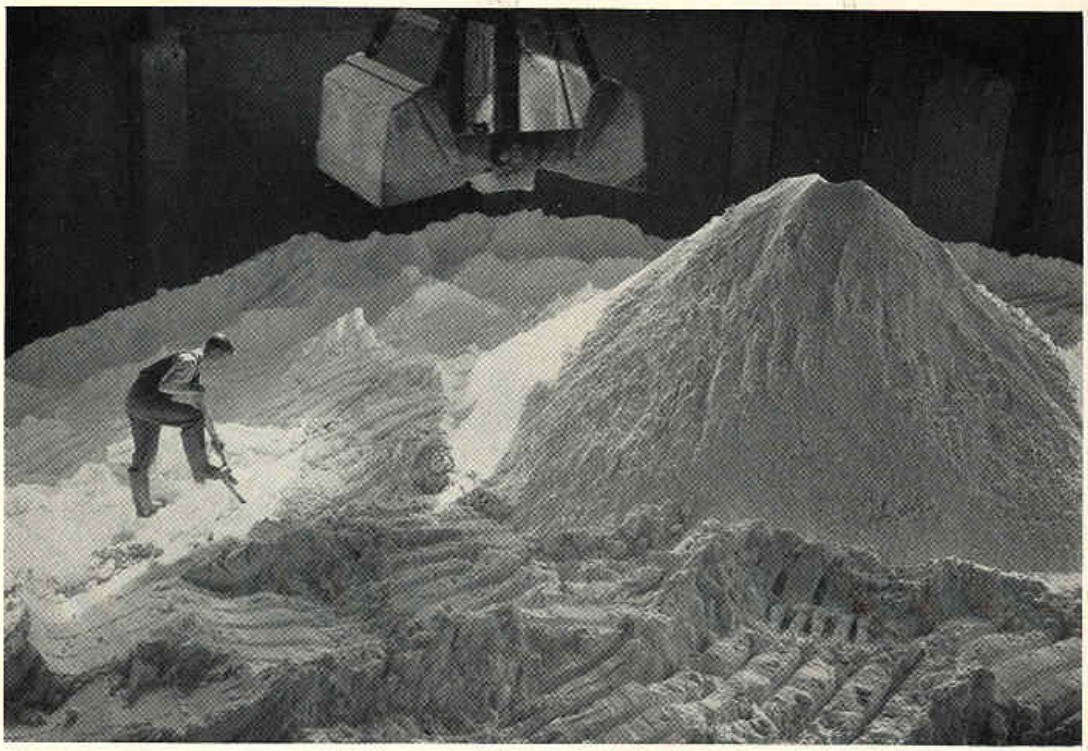
TOP RIGHT: *Varnish impregnating plant*

BOTTOM RIGHT: *Space heaters in factory*

BELOW: *Air conditioned compartment, gear hobbing shop*





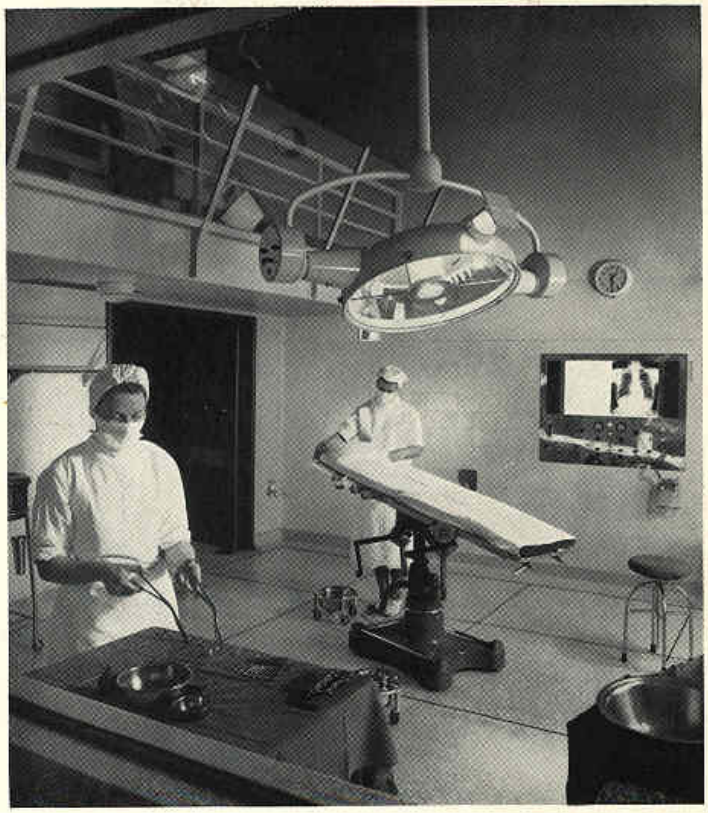


MURGATROYD'S

SALT & CHEMICAL CO. LTD.

MIDDLEWICH

The larger photograph is not of a film set on which a panting star struggles up the last few feet of a cardboard mountain, but of one of the processes at the works of the Murgatroyd's Salt and Chemical Company at Middlewich. In a way it is just as romantic, if you think of what happens to your kitchen salt on a wet day and multiply your problem to this gigantic scale. Like so many of the operations of chemical sleight-of-hand, this one depends on an esoteric maze of pipework.



QUEEN VICTORIA HOSPITAL

EAST GRINSTEAD

During the last war the Queen Victoria Hospital at East Grinstead became a household word through the wonderful plastic surgery of Sir Archibald McIndoe and his team. Here is one of the four operating theatres in which disfigured men are given a new life. In this stark but rather beautiful room particular cleanliness is demanded. Air is therefore fed into it mechanically through a special filter and washer—the surgeon controlling the temperature—and is extracted through outlets at floor and ceiling levels.

LEYLAND MOTORS LTD.

MINISTRY OF SUPPLY FACTORY

To melt the Polar ice-caps would still present technical difficulties, but in theory the heating engineer should be ready to undertake anything, however vast, however cold, without showing unmanly surprise. In practice, however, even the most experienced eyebrows rise a trifle at some of the outsize requirements of modern industry. One of these was the heating of Leyland Motors' new factory in Lancashire, which has a cubic capacity of 35 million cubic feet.

This demanded an installation on a quite exceptional scale. The high pressure hot water system which we engineered for the whole factory has four boilers and provision for a fifth. Present hourly output of these monsters is 184,000,000 B.T.U.s or sufficient to look after the central heating and hot water supply of about 8,000 post-war houses—that is, a sizeable small town, or the equivalent of about fifteen of the typical District Heating Schemes that have been completed in this country since the war. The boilers' consumption is reasonable, but nevertheless prodigious. Oil fuel is delivered a train load at a time and pumped direct from the tanker wagons into large storage tanks near the boiler house. Just to keep the oil warm and fluid in its journey from train to burners is the work of two fair-sized steam boilers. The biggest heating pipes are 16-in. in bore, while those that take the high pressure hot water to the factory are 12-in. They would have been bigger still if we had not decided to run the system at the highish water pressure of 225 p.s.i.

The air heaters which distribute warmth in the main works also ventilate the buildings, and in the summer can cool them to the inspiring tune of eighty tons of fresh air each minute.

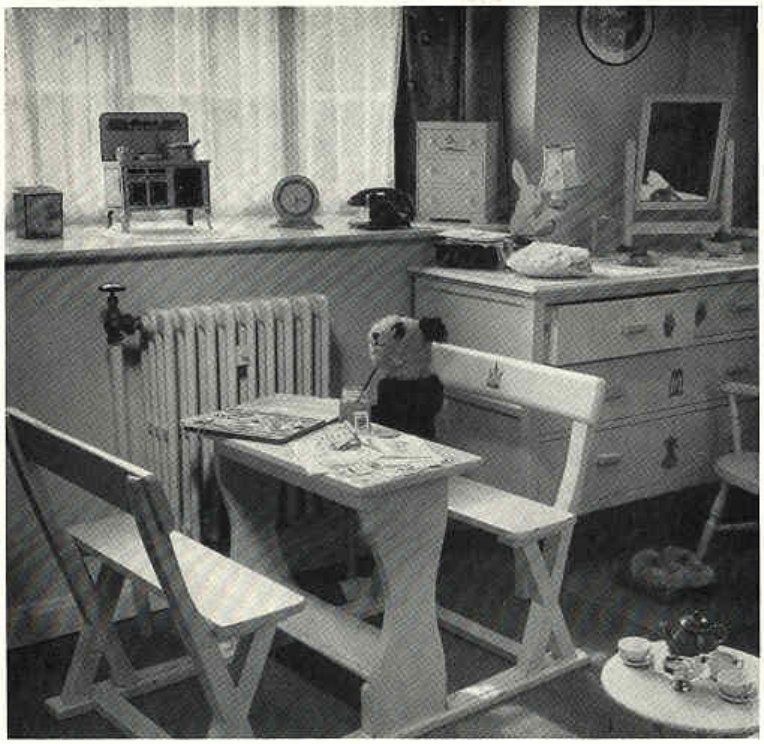
Our part in the design of this big layout called for heroic efforts from the drawing office; it was not merely the gigantic area of the installation, but the exceptional speed with which the work had to be carried out. From initial conception to completion took only two years and the actual erection on site, where we deployed up to 140 men, rather less than twelve months.

One feature which gave us particular satisfaction was the successful use of waste heat. We were able to turn to this as a supplementary source for warming a section of the factory where very large electric currents are needed for welding, when we discovered that we could tap the heat liberated by the diesel engines that drive the generators. And the excitement of getting something for nothing is also to be found in the canteen, for here the steam for cooking can be produced from rubbish burnt in the incinerator. Should rubbish run out, the system can be switched to oil.

In so comprehensive an engineering job numerous other services had of course to be provided. For example, we ran three and a half miles of 6-in. piping for compressed air, gas and water mains. And some of the specialized buildings are interesting. The paint shop is important as a large consumer of heat. Not only must vast quantities of air be circulated for human health, but the room has to be kept at about 78 deg. F. in the depth of winter for the benefit of the paint. This means a maximum heat demand of 10,000,000 B.T.U.s/hr.

And in the Standards Room, that sanctum of the modern works where all the measuring instruments keep guard on the mechanical conscience, there is a piece of plant of daunting complexity. Here, day and night throughout the year, the temperature must not vary more than $1\frac{1}{2}$ deg. F., so that the controls have to be almost human; in some ways, indeed, superhuman, for they have the heavy responsibility of deciding the end of winter and the start of summer and of changing over accordingly from heating to cooling. The difficulties of this decision, at which the Meteorological Office might quail, are not lightened by the fact that it has to be made for two separate rooms and that at certain seasons one of them may need to be heated and the other cooled.

Leyland Motors, Ministry of Supply Factory



A WARM HOUSE IN ENGLAND

High among the reasons why the Americans find us such funny people is our national custom of toasting our faces and leaving our backs to freeze, a procedure as unkind to our faces as to our backs. The cult of the open fire is very dear to the English heart, like roast beef on Sundays and the herbaceous border; it is something for which we are all prepared to die, and every winter most of us nearly do. What it means, now that housemaids have all become factory inspectors or Members of Parliament, is that while one room in the house may possess mild thawing properties, the rest are insupportable without full polar equipment. Considering the refrigerative powers of the average English bedroom it says a great deal for our characters that murder is so rarely committed at breakfast.

But it would say more for our common sense if we approached the idea of central heating with a little less bias. Compared with the open fire it is much more efficient and nothing could be simpler, cleaner or more reliable than a gas-fired boiler, heating a system of radiators and providing a never-failing supply of hot water. The nursery illustrated above, part of quite a modest house, is pleasantly warm day and night and so are all the other rooms. A small gas boiler performs this magic efficiently, without attention, and looks after an airing cupboard as well. There is really nothing unpatriotic in protecting ourselves against the barbarity of the English climate.

C. A. PARSONS & CO. LTD.

RESEARCH & DESIGN BUILDING

In recent years few Americans have thought of building offices, banks or public buildings without applying acoustic treatment to their ceilings. And for many years we, in this country, have preferred to warm such buildings by radiant heat from above. These two treatments were incompatible until a Norwegian married them by inventing a method of warming the typical American acoustic suspended metal ceiling. We have recently formed a British Company to sell this Frenger ceiling through our industry and we and many of our architect friends have found that it solves a lot of problems.

It consists of light perforated aluminium panels clamped, not to conventional bearers, but to a grid of piping treated to resist corrosion and connected to a hot water circuit; over the panels is laid an insulating and sound-absorbing blanket. Unlike many such ceiling surfaces, this looks pleasant and does not warp with age, and scores over the embedded panel system by responding immediately to changes of temperature. The main purpose, of course, is to provide warmth and absorb sound, but it has another useful attribute, forming a light removable sub-ceiling. Above this the architect and engineer may safely recess lighting fittings and

conceal ventilating ducts, heating mains, waste pipes and all the piping services of a modern building. An easy solution is thus provided to a problem that worries every architect—particularly in the laboratory. Moreover, in special cases where abnormally high rates of air change are needed, ventilation through this ceiling allows an even distribution of air, for its passage through the perforations has no effect on sound absorption.

This ceiling solved the problem of C. A. Parsons & Co. Ltd. in their big new research building in Newcastle. In their great drawing offices they wanted continuous fluorescent lighting tubes at very close centres. Together we devised a variant on the flat Frenger ceiling so that it forms a series of troughs of anodized aluminium in the shape of reflectors, yet still performs its other functions of heating and sound absorption. Elsewhere the Frenger ceilings are flat, but anodized to suit Parsons' requirements. Both kinds cover nearly 80,000 square feet.

On entering any of these very big drawing offices, one is amazed at the restful quietness that avoids distraction and encourages concentration, and it is difficult to realize that there are probably thirty or forty conversations and many telephone calls going on unnoticed.

What other device warms you and is pleasing to the eye; absorbs external noise and makes talk unstrained; conceals and yet gives access to ugly pipes and ducts; avoids the need for plaster and increases the speed of building?

It is a satisfaction to have found and developed this system for the comfort of our clients, but it is truer of this than of many new contrivances that its full effect must be experienced to be believed.

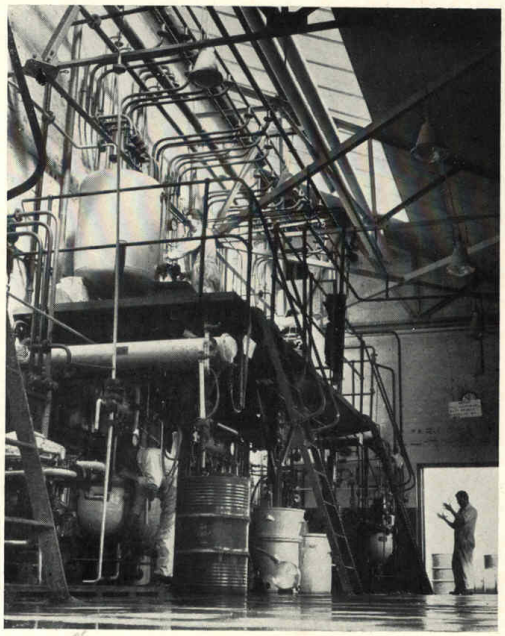
C A Parsons Research Building
Note the trough shaped Frenger ceiling with continuous fluorescent lighting

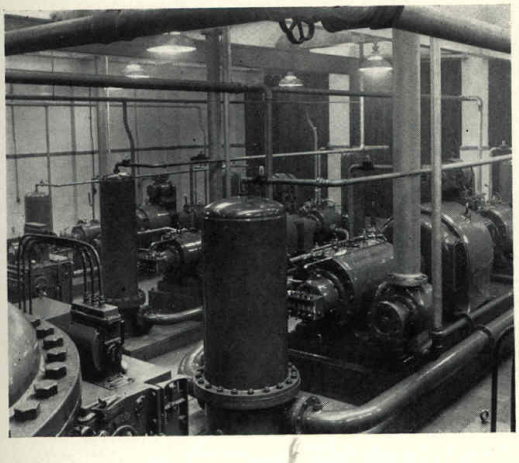
ORGANON LABORATORIES

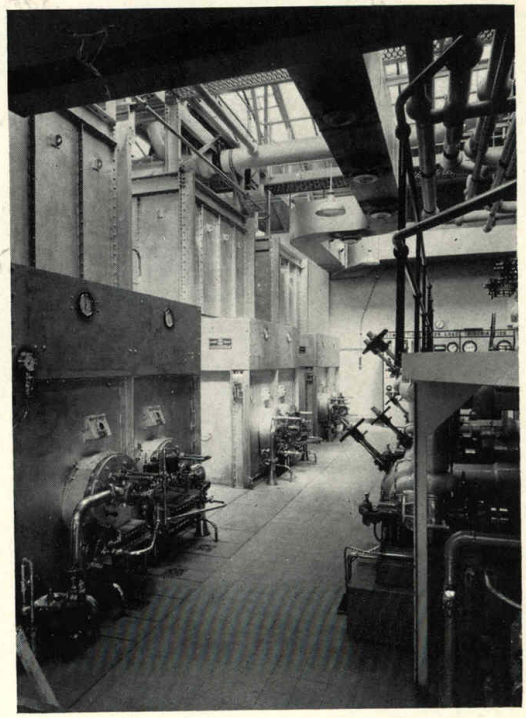
GLASGOW

Do not ask us to explain the production of synthetic hormones. Science must always have her mysteries for the common man, and this one is so deeply occult that, as you can see, its female initiates are obliged to wear yashmaks. Enough to say that even the most innocent synthetic hormone will elude capture unless you have armed yourself with a tremendous spider's-web of efficient pipework, such as we illustrate from the Organon Laboratories, Glasgow.

The right-hand picture shows a good example of the range of the Company's activities. It is easy to imagine that because we are heating engineers we confine our circuits to hot water. But the witch's brew hatched by many modern chemical engineering plants requires all kinds of strange fluids to be carried through networks of pipes like those in the picture—from the heaviest and most viscous, which must be kept warm to prevent them from going solid, to gases of the most obscure varieties.







GILLETTE INDUSTRIES LTD., ISLEWORTH

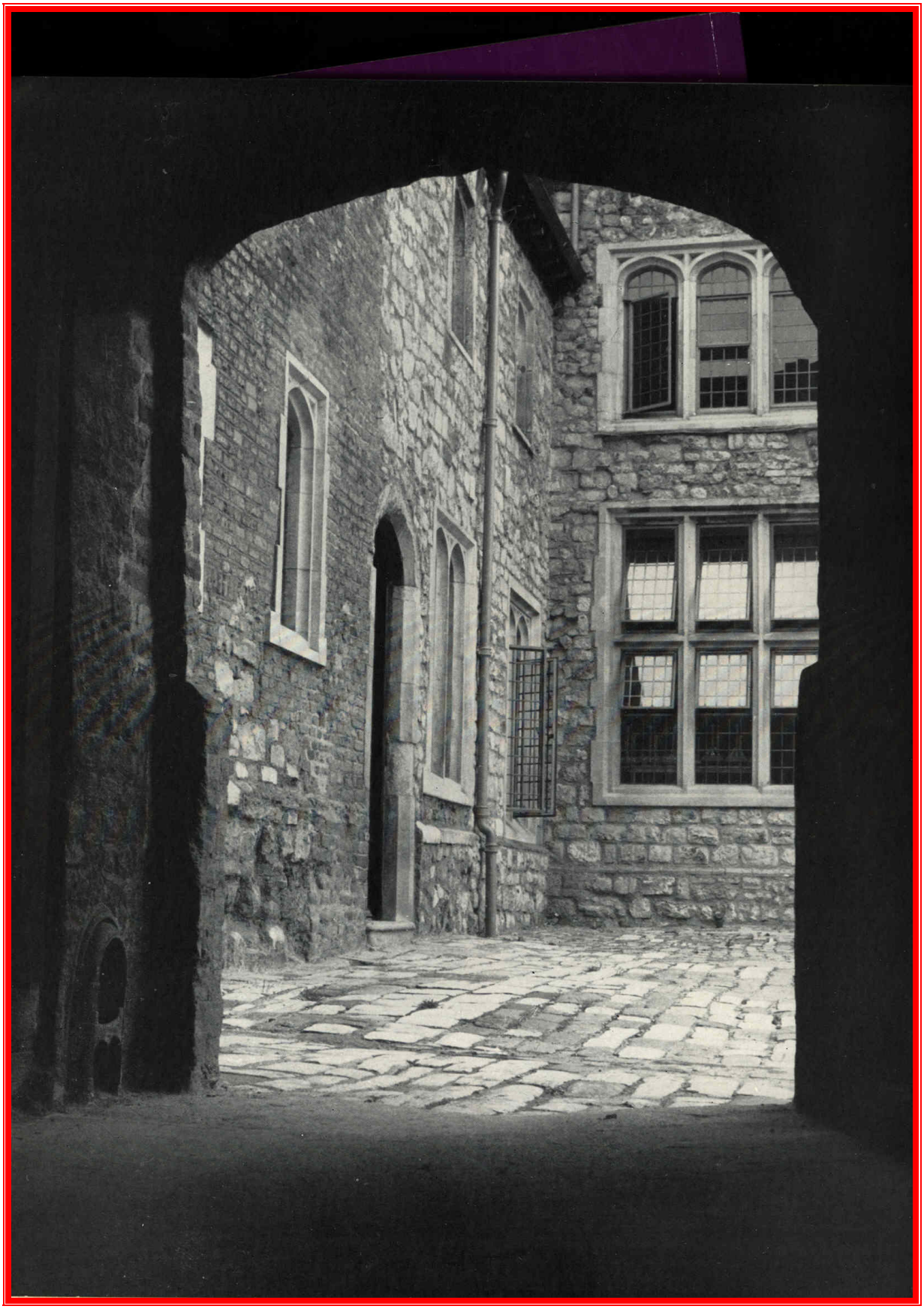
The heating engineer has to worry about the welfare of machinery as well as that of human beings. An instance of this arose when we were called in by Gillette Industries Ltd. when they discovered that their high pressure hot water mains required urgent replacement. This was an emergency; and although materials were in very short supply, and all work had to be carried out while the plant was in full production, an entirely new service of heating mains was speedily installed without interruption to the working of the factory.

At about the same time Gillettes decided that their boiler plant and air compressor equipment were inadequate for increasing production, and we were asked to design a suitable installation with sufficient capacity for their future requirements.

A new building was erected to house the equipment. The right-hand photograph shows the boiler plant and the other the air compressors. Much of the manufacturing plant is operated by compressed air which must be absolutely dry. In front of the compressors can be seen the Silica Gel drying units through which the compressed air is passed before being delivered through the new ring main system which we also designed and erected.

In addition to these major works we have installed several extraction and ventilating systems in the Gillette factory, an example being equipment for the removal of gases given off by quick drying inks on the wrapper printing machines.

Gillettes were always more than satisfied with the promptness with which we tackled their problems, and when later they urgently required suitable plant for the manufacture of their new cosmetic, White Rain, they came to us again, as you will see later.



Charterhouse

CHARTERHOUSE

Nobody today claims to be an Old Chartreusian, but it would have been a nice tribute to the skill in cordials of the parent monks if the Old Carthusian tie were green and yellow. When Charterhouse School moved out to Godalming in 1872 it left historic buildings in the City. The original chapel was founded in 1349 as an intercession for those dying in the Plague. Twenty-two years later it became a Carthusian monastery and by the time Henry VIII got to work was a plum worth picking. He picked it with a brutality that seemed to leave a voodoo over the property, bringing a series of noble owners to distressing ends, until at last it was bought by a merchant named Thomas Sutton, who when he died in 1611 set up a new foundation consisting of a chapel, an almshouse and a school.

The eighty pensioners of the almshouse were to be over sixty years of age, 'gentlemen by descent and in poverty, soldiers who have carried arms over sea and land, merchants whose livelihood was destroyed by shipwreck, or other misfortune, or servants in the royal household'. Those who had been captive to the Turks were also eligible and a long line of distinguished men with reason to be grateful to Thomas Sutton has included Hakluyt, Johnson's secretary McBean and Stephen Gray, one of the pioneers of electricity.

During the last war the hospital was badly damaged by bombing, but much of it has now been restored. Most of the old stones are still usable, to link six hundred years of history. And to the contentment of the adventurous old gentlemen 'of good behaviour', and with deference to the ancient building, we have designed and installed an oil-fired heating system.

CHURCHILL GARDENS

CITY OF WESTMINSTER

Churchill Gardens, the Westminster City Council's striking new buildings rising along the River in Pimlico, and Dolphin Square, one of Europe's largest single blocks of flats, are warmed and provided with hot water from central installations. More than 2,000 flats are already served, but no fuel of any kind is burnt on the site of any of the buildings. Battersea Power Station provides the clue to this apparent mystery and the heat for some 5,000 people.

We cannot claim to have executed the whole of this interesting scheme, though the installations within the buildings are ours and the principle adopted by the Consulting Engineers of using the waste heat resulting from electrical generation is one that we have often used in the past.

Even the most modern generating station produces about twice as much heat as electricity. This is not due to carelessness on the part of the British Electricity Authority, but is a limitation imposed by physical laws when fuel is burnt to produce electric power. If the maximum of electrical energy is to be obtained from each ton of coal burnt, the unavoidable by-product of waste heat must be liberated at low temperatures and is usually jettisoned in our rivers or atmosphere. As a result the former are warmed a few degrees—seldom enough for the comfort of swimmers—and the latter burdened with clouds issuing from the concrete cooling towers which are now part of our skyline.

At Battersea some of the turbine plant has been designed to discharge the exhaust steam at a higher temperature and pressure than is usual. Rather less electricity is generated, but instead of being wasted in the Thames the energy available in the exhaust is used to heat water in a closed circuit to about 200 deg. F. This water is pumped through pipes (carried in a tunnel under the Thames) and stored in a huge insulated tank inside the glass tower shown in this picture.

Hot water is circulated from this vast 'Thermos' flask at controlled temperatures, and distributed through the new blocks of flats and also to Dolphin Square. Here, in the interests of national fuel economy and to reduce smoke pollution, the three original boiler houses containing twenty large automatic boilers, which we commissioned in 1937, have been converted to heating and hot water supply sub-stations.

When the scheme is fully developed, what was once thrown away will provide warmth and hot water for more than 10,000 people.

Churchill Gardens, Westminster

Liverpool Cathedral

LIVERPOOL CATHEDRAL

Irregular only in their verbs, the Romans believed in warm feet and cool heads, and so invented a hot air system circulating under the floors of their villas. In our unsettled era, when so many staggering innovations grow obsolete while still in infancy, it is pleasing to note that for one purpose at least the hypocaust remains unbeaten. This is in the special field of the cathedral, where we have the problem of a huge space only needing to be warmed for the first few feet above the floor.

The heating of Liverpool Cathedral was planned before the foundations were laid and it was therefore possible to install a modern version of the hypocaust, which turned the entire floor into a vast radiator. We used the Roman method because its structure has been proved to survive intact for nearly two thousand years, and cathedrals must be made to last.

At the time we prepared this design ducts in the floor itself were considered more permanent than metal pipes embedded in it; but just before the last war, when we were asked to design the system for the new cathedral at Guildford, we decided that copper pipes laid in concrete just below the floor surface were likely to prove as permanent and offered certain advantages of simplicity and economy. It is rather easier, for example, to pump hot water through small pipes than hot air through small ducts. More recently, we have used the same system in Sheffield and Manchester Cathedrals and it will also be used in future extensions at Liverpool.

There, air heated by gas-fired appliances is forced by electrically-driven fans through a closed system of small ducts immediately below the floor surface, the same air being continuously circulated so that the ducts do not become choked by dust. In this way the floor surface can be maintained at a temperature sufficient to warm comfortably the occupied part of the cathedral with notable economy, and without being too hot for the feet.

Trafalgar Square fountains

TRAFALGAR SQUARE FOUNTAINS

No one has ever succeeded in establishing the optimum splash of a national fountain. A jet the height of St Paul's would delight everybody except those obliged to live in mackintoshes to windward; on the other hand the new fountains in Trafalgar Square struck the grumbling public of 1850 as being ignominious squirts unsuited to express either the glory of England or the tactical mastery of Nelson. The view that they should be higher and wetter went officially unheard until just before the last war, when Sir Edwin Lutyens was commissioned to make them more exciting, as part of a memorial to Lord Jellicoe and Lord Beatty.

The remodelling was finished in 1948, and even among the pigeons grumbling ceased as the jets were seen to climb effortlessly to 80 feet, an altitude deemed sufficient to satisfy all reasonable patriotic feeling. Behind the 4,000 gallons a minute of this popular spectacle is an entirely new system which we installed to the design of the Ministry of Works. In addition to the control equipment there are three large pumps—one for the central jets, one for the cascades and another for the bronze figures. Below the Square electric motors to the tune of over 200 horse-power work untiringly for the pleasure of London.

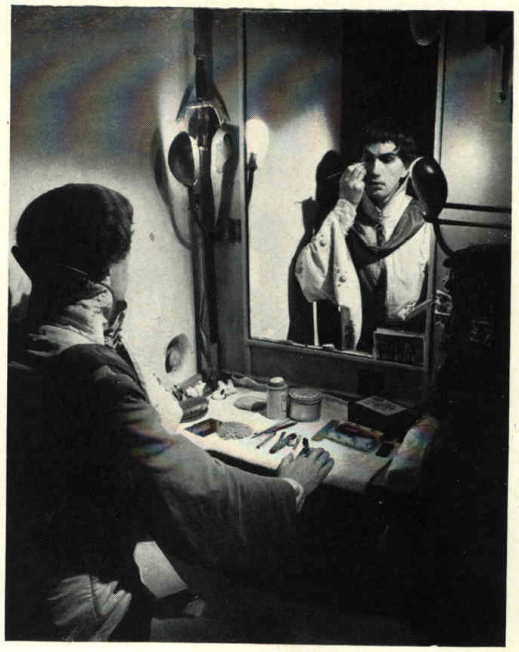
SHAKESPEARE

MEMORIAL THEATRE

STRATFORD-UPON-AVON

No dramatic author has so far had the humanity to allow for the English climate in his stage directions; as for example—'After October 1 the Queen of the Fairies must have a fur rug in her chariot, the Beggar is to be provided with good boots and suitable arrangements in wool must be made for all nymphs, elves and hob-goblins.'

Sitting nicely muffled in the stalls we seldom spare a thought for the brave souls on the other side of the footlights who are pretending that the Athenian sun is scorching their freezing limbs. It is better not to imagine the agonies of gooseflesh and suppressed sneezes suffered in Victorian theatres during the Arctic pantomime season. Nowadays managements realize that good heating backstage is essential to good acting, and this was impressed on us when we installed the original heating and ventilating systems at the Shakespeare Memorial Theatre at Stratford. Since then we have added controlled invisible warming panels in the ceilings of the dressing-rooms, so that even Titania can keep snug.



SOUTHAMPTON

CIVIC CENTRE

Asked by an intelligent foreigner to explain the purpose of a new civic centre about half the size of Westminster Abbey, someone replied that the mayor had to have somewhere to hang his chain. But in fact the most cynical ratepayer must admit the tactical advantages of gathering all the municipal services under one roof. And a subsidiary benefit which no one can deny is the opportunity this offers for heating the whole machinery of the local government through one economical system.

Most of Southampton's cultural as well as administrative activities are carried on in the Civic Centre completed in 1939. The heating and hot water supply services are fed from four oil-fired boilers, and the temperature of each part of the building is regulated from a central control panel in the boiler house. A fifth boiler not only supplies hot water to wash-basins and canteens, but also heats the airing rooms in the police station, where rheumatism is summarily arrested.

GILLETTE INDUSTRIES LTD, ISLEWORTH

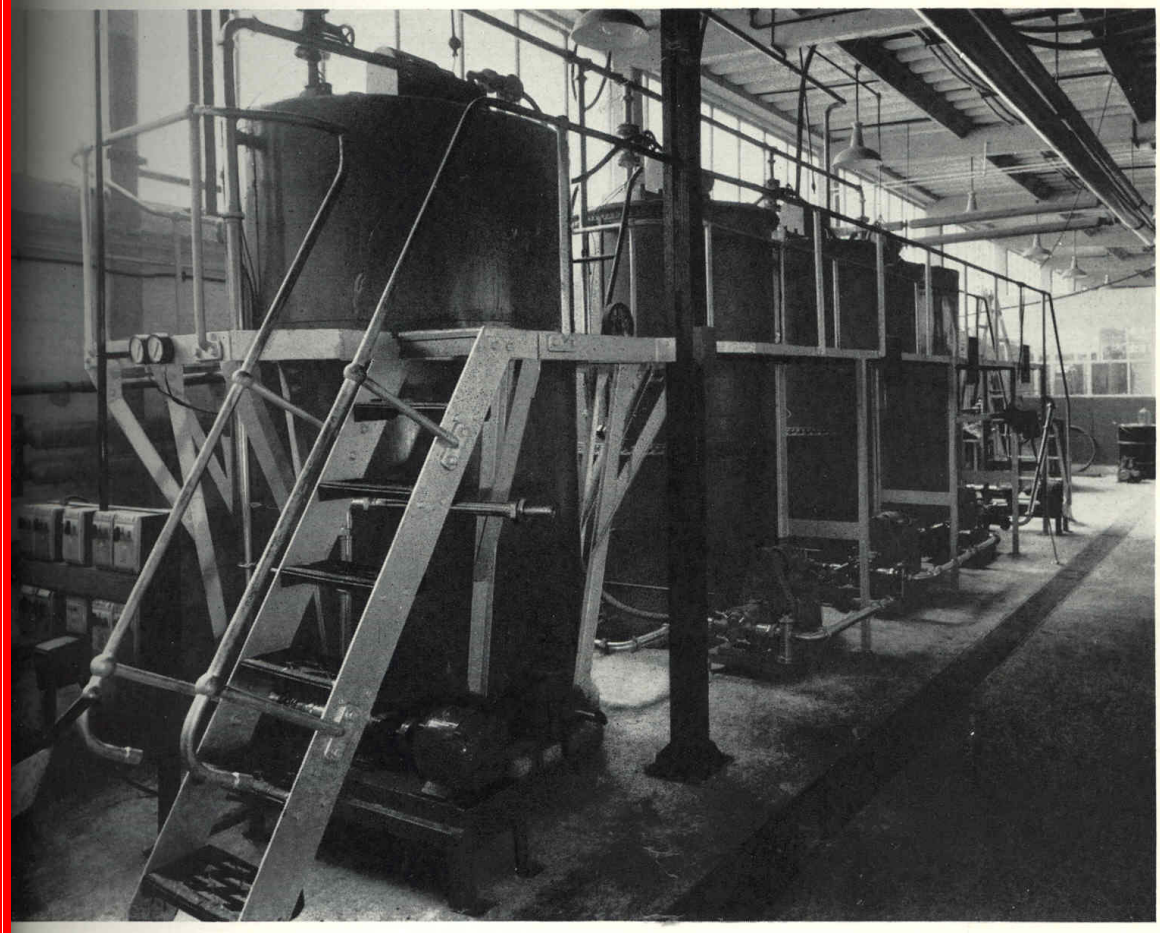
In order to beautify the female head, 'White Rain' does not simply fall from heaven, and so Gillettes decided to come to us rather than the Meteorological Office. Their urgent desire to produce a deluge of their now famous cosmetic as quickly as possible ruled out extensive experiment, and meant that our engineers had to rely on an inspired assessment of the scanty data available about the heat transfer characteristics of the ingredient chemicals. Here again, due to shortages, existing and alternative materials had to be adapted.

The finished plant consists of four jacketted stainless steel mixing vessels, a large stainless steel tubular heat exchanger, stainless steel pumps for filling and emptying the product, and stainless steel interconnecting piping. One of the four vessels is used for mixing the ingredients, while the other three are for cooling and storage.

Up against a fresh problem the designer sometimes turns to simple old devices whose efficacy has long been proved, often in the humblest ways. Our main difficulty was heating, for the medium available in the Gillette works was high pressure hot water. If this had been directly employed in the heating jacket a high pressure vessel would have been needed, of very heavy and costly construction. Not for the first time we thought of kitchen practice, and, remembering the large pans used in farmhouse dairies for boiling milk, gave the parent vessel a jacket which is filled with water at atmosphere pressure and heated (it can be boiled if necessary) by an immersed pipe coil through which high pressure hot water is pumped. The result would be recognized by any chef with a proper affection for his sauces as a glorified *bain-marie*.

The stainless steel of which the four vessels are made is comparatively thin, and for the outer jackets we were able to use portions of an old oil refinery fractionating tower which happened, by a lucky chance all too rare in engineering, to be of exactly the right size. In each vessel a stainless steel propeller type stirrer is driven by an electric motor. The stainless steel heat exchanger which cools the product on its way to storage is made entirely of new materials to our own design.

That we have so far had to mention it seven times shows there was no guesswork about stainless steel, which was clearly vital to so delicate a process. But our design had to cover such difficult questions as how much pipe coil to put in the jacket, how fast to stir and the optimum rate of flow for the cooling water. Naturally we were eager to discover how near the mark we had been, and when the plant went into production we were delighted to learn how close we had got to fact. We found, indeed, that a modest reserve capacity had been established, so that a somewhat shorter cycle of operation was required than we had cautiously supposed.



Gillette Industries, Isleworth

PIER APPROACH BATHS, BOURNEMOUTH

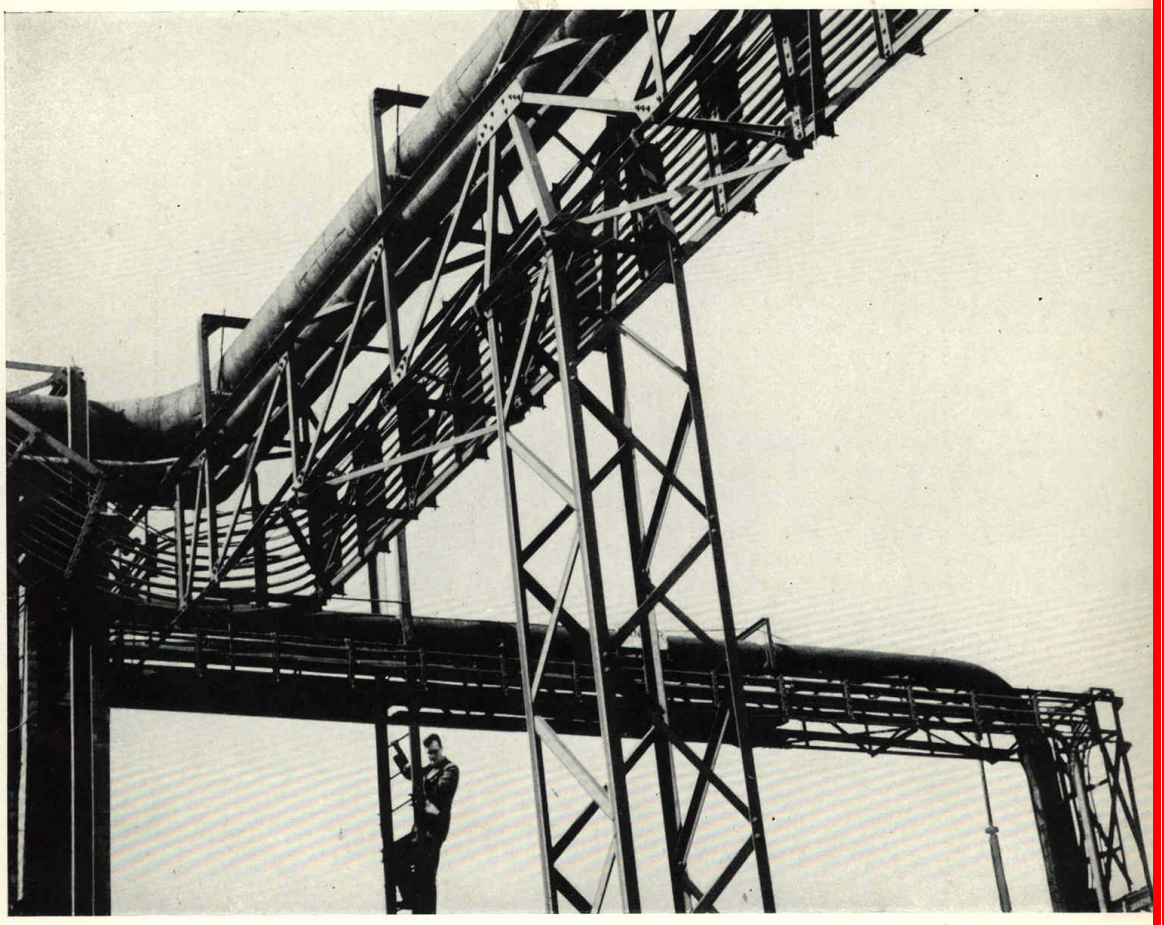
We once stayed at a remote hotel in France where for our convenience a bonfire was lit under the bath, to the admiration of the villagers, most of whom called in with advice. The Mayor worked the bellows. It was indeed a dramatic method, but it left us blacker than when we started, and the suggestion of cannibal preparations was disturbing. For larger stretches of water, such as an indoor swimming-pool, electricity provides a cleaner and more elegant medium, and sidetracks the problems of smoke, fuel storage and ash removal which cannot always, with solid fuel, be easily solved.

When the Pier Approach Baths at Bournemouth were completed in 1937 electricity could be obtained cheaply at night, when the demands on the power stations were largely limited to the supply of the modern equivalent of midnight oil.

The plant we installed uses electricity at night to heat 40,000 gallons of water, which are stored in four large insulated vessels. By early morning this water is heated to about 240 deg. F., the supply of electricity is then shut off, and the hot water circulated through heat exchangers provides all the heat required to keep the pool at swimming temperature and the whole building warm all day. It also heats the water for the slipper baths.

The Turkish Bath Suite has its own electrically heated air system, which brings tropical satisfaction to even the most senior ex-residents of Poona.

Pier Approach Baths, Bournemouth



THE GENERAL ELECTRIC CO. LTD., WITTON, BIRMINGHAM

The outfit in the photograph is reminiscent of those beautiful overhead railways on which haberdashers used to send change whizzing among their customers' hats, but the man on the ladder, who suggests the scale of the work, would be surprised to receive his pay-packet by such means. In fact this gantry is concerned with a sterner load than farthings. It carries an 18-in. main taking low pressure steam for heating, a 5-in. one supplying high pressure steam for process and also a 4-in. condensate return main—all running conveniently out of the way even of giraffes, twenty-seven feet above the ground, and a good example of a large pipeline installation designed and erected by the Company.

These mains have been installed at the G.E.C.'s new heavy engineering works at Witton, and serve a building of 2½ acres where a wide range of electrical machinery is made and tested, including hydrogen-cooled turbo-alternators, water wheel alternators, and large electric motors. By the most modern means the factory is heated, and supplied with hot water, process steam, gas, compressed air and domestic water. In brief, everything the engineer could wish for is brought to him in a pipe, except beer and tobacco.

A widening field

As you will see from the list which follows—in itself a selection—the work described in this booklet represents only a small proportion of our activities, which embrace a far wider field than is implied by the plain label 'Heating and Ventilating Engineers'. We believe we can fairly claim today to be among the leaders in the design and installation of most of the engineering services required for modern buildings and manufacturing processes.

Both at home and abroad the continuous experience of one hundred and thirty-eight years is at the disposal of those interested in the expert use of the newest methods in this field. That is not a boast, but a fact, of which we are modestly proud. In a word where everything is becoming larger and more complex we have constantly to adjust ourselves. We have to go on learning and are glad to do so.

Heating and ventilating and their allied branches are in essence little more than the practical application of the basic laws of Physics and Mechanics. The principles which governed the design of the warm air stoves made by our founders for the last of the Georgians remain valid, but our inherited skill and ever-growing technical knowledge of the extensions of these laws enable us to solve the engineering problems of today unobtrusively and with economy.

Whether the plans on our desk are for the welfare of a few toads, of the inhabitants of a vast building, or of some intricate industrial process, we believe we have the latest answers. And we hope this booklet will have shown that our belief is shared by critical judges.

SOME TYPICAL INSTALLATIONS

HOUSES

Clifton Housing Estate, Nottingham
National Coal Board Housing Estates—Coventry, Chesterfield, Mansfield
Priory Street Development, Poplar
Meadow Road and Maybridge Housing Estates, Worthing

FLATS

Chaucer House, Pimlico
High Point, Highgate
Priory Green Estate, Finsbury
Tanys Dell, Harlow New Town
Dolphin Square, Chelsea
Fountain House, Park Lane
Marsham Court, Westminster
Tybalds Close, Holborn
Westminster Gardens, Westminster

HOTELS

Palace Court Hotel, Bournemouth
Welcombe Hotel, Stratford-on-Avon
Station Hotel, York
Imperial Hotel, Torquay
Royal Bath Hotel, Bournemouth
Carlton Hotel, Bournemouth
Queen's Hotel, Leeds
Grand Hotel, Sheffield
Sun Inn, Troutbeck

NEWSPAPER OFFICES

Punch Offices, Bouverie Street
Daily Express Offices, Fleet Street
Daily News and *Star* Offices, Bouverie Street
Daily Echo Offices, Bournemouth

OFFICES

Carliol House, Newcastle
New Government Offices, Whitehall Gardens
South Africa House, Trafalgar Square
India House, Aldwych
Ship Canal House, Manchester
Commonwealth House, New Oxford Street
R.I.B.A. Headquarters, Portland Place
Hanover House, Hanover Square
Aldwych House, Aldwych

FACTORIES

B.T.H. Ltd., Rugby, New Turbine Shop
Gillette Industries Ltd., Isleworth
Accles and Pollock Ltd., Oldbury
Henry Meadows Ltd., Wolverhampton
Bengers Ltd., Coleraine, Londonderry
Pye Radio Ltd., Cambridge
C. A. Parsons & Co. Ltd., Newcastle-upon-Tyne
W. T. Henley's Telegraph Works Co. Ltd., Birtley
Cerebos Salt Ltd., Acton

HOSPITALS

Hammersmith Hospital, Linear Accelerator and Cyclotron Suite
St Helier Hospital, Carshalton
Lennox Castle Mental Hospital, Glasgow
Coventry and Warwickshire Hospital, Coventry
Leeds Infirmary
Hellesdon Hospital, Norwich
Nottingham General Hospital
Royal United Hospital, Bath
Westminster Children's Hospital
King George V Hospital, Malta

HISTORIC BUILDINGS

Buckingham Palace
The Charterhouse
Castle Howard
Wentworth Woodhouse
Bridgwater House, Westminster
The Forecourts, Dublin
Arus and Uachtarain, Dublin (The President's House)
Chetham's Hospital and Library, Manchester
The Dome, Brighton

CATHEDRALS

Canterbury Cathedral
St Paul's Cathedral
Westminster Abbey
Liverpool Cathedral
Westminster Cathedral
Guildford Cathedral
Manchester Cathedral
Bath Abbey
Oban Cathedral
St David's Cathedral

PUBLIC BUILDINGS

Southampton Civic Centre
Norwich City Hall
Royal Exchange, Manchester
Leeds Civic Centre
Hertfordshire County Offices, Hertford
Wiltshire County Offices, Trowbridge
Swansea Guildhall
Cambridge Guildhall
Watford Town Hall
Stormont Castle, Belfast

CINEMAS AND THEATRES

Shakespeare Memorial Theatre, Stratford-on-Avon
Leicester Square Theatre
Coventry Hippodrome
Apollo Cinema, Manchester
The Metropole, Dublin
Lewisham Hippodrome
Regal Cinema, Edmonton
Odeon Cinema, Jersey
Gaiety Cinema, Brighton

INDUSTRIAL PROCESS SERVICES

B.T.H. Ltd., Rugby, Transformer Drying Plant. Constant temperature equipment for Gear Hobbing Shop. Process pipework for Resin Factory
Rootes Ltd., Ladbroke Hall, Spray Booths
Rothervale Phenols Ltd., Sheffield, Distillation Plant
Murgatroyd's Salt and Chemical Co. Ltd., Middlewich, Power Station Pipework
G.E.C. Ltd., Witton, Process Mains
Stewarts and Lloyds Ltd., Corby, Oil Firing for Continuous Strip Mills
Thrupp and Maberly Ltd., Cricklewood, H.P.H.W. Process Mains

BANKS

Lloyds Bank Ltd., Head Office, London
Bank of Ireland, Dublin
Martin Bank Ltd., Head Office, London
District Bank, Head Office, Manchester
Standard Bank of South Africa, Johannesburg
Imperial Bank of Iraq, Kuwait
Hong Kong and Shanghai Bank, Hong Kong

UNIVERSITIES

Cambridge—Girton College
Oxford—Magdalen College
Bangor—University Buildings
Bristol—University Buildings
Manchester—Engineering and Arts Buildings
Southampton—University Buildings
Aberdeen—Medical School
London—London School of Economics
Nottingham—Halls of Residence
Reading—Dairy Department

LIBRARIES

Bodleian Library, Oxford
University Library, Cambridge
Library of the University College, Exeter
Rylands Library, Manchester
London Library, St James's Square
University Library, Bristol
Library of the University College, Swansea

POWER STATIONS

Brunswick Wharf, Poplar
Cliff Quay, Ipswich
Croydon 'B'
West Ham
Littlebrook, Dartford
Bromborough
Woolwich
Blackwall Point
Deptford East

ART GALLERIES AND MUSEUMS

The Aquarium, Brighton
Dulwich Picture Gallery
Norwich Castle Museum
Russell Coates Art Galleries, Bournemouth
Bristol Museum

SWIMMING BATHS

Pier Approach Baths, Bournemouth
Public Baths, Aberdeen
Public Baths, Epsom
Public Baths, Shirehampton, Bristol
King Alfred Baths, Hove
Public Baths, Lancaster
Public Baths, Eltham, Woolwich
Speedwell Baths, Bristol
Public Baths, Cheam

LABORATORIES AND RESEARCH STATIONS

London School of Hygiene and Tropical Medicine, London University
Chemistry Laboratory, Aberdeen University
Shirley Institute, Didsbury
Biology Laboratory, Exeter University College
Zoology Laboratory, Reading University
National Physical Laboratories, Teddington
Nuclear Physics Laboratory, Liverpool University
Chemistry, Zoology and Physics Blocks, Southampton University
A.S.R.E., Portsdown, Portsmouth

SCHOOLS

The Royal School, Bath
Barclay School, Stevenage
The Susan Lawrence School, Poplar
Manchester Grammar School
Bradfield College
Winchester College
Stowe School
Ampleforth College
Charterhouse School

OVERSEAS

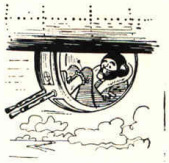
Royal Palace, Baghdad
West Station, Baghdad
Parliament Buildings, Ankara
U.S. Ambassador's Residence, Ankara
Palace of Justice, Teheran
Palace of Finance, Teheran
Alexandria Medical Institute
High Commissioner's Offices, New Delhi
Whaling Station, South Georgia
Wesley College, Kumasi
Central Hospital, Kumasi

DISTRICT HEATING SCHEMES

Stott Estates, Flixton
Brynmawr Housing Scheme
Urmston, Manchester

SHOPS AND STORES

Bobby's, Bournemouth
Bright's, Bournemouth
Bourne & Hollingsworth, Oxford Street
John Barnes, Finchley Road
C. & A. Modes, Oxford Street
Liberty's, Regent Street
Moyses Stevens, Victoria Street
Robinson and Cleaver, Regent Street
Co-operative Stores, Newcastle



WAR-TIME INSTALLATIONS

Central Ordnance Depot, Donnington
Over 100 R.A.F. Stations
Vickers Armstrong, Blackpool
Concrete Floating Dock for the Admiralty
St Paul's Underground Control Station for the C.E.B.
Combined Operations Underground Headquarters, Plymouth, Portsmouth and Dover
Mobile Disinfestors for the Royal Army Medical Corps
Royal Ordnance Factories, Rearsby, Drigg and Bridgwater

UNUSUAL INSTALLATIONS

Zenopus Laevis Toad Tanks, Royal Portsmouth Hospital
Piggeries, Shinfield
Water supply for Langton Herring Farms, Weymouth
Refuse Disposal Works, Worcester Park
Mushroom Houses for Aylesbury Mushrooms Ltd
Wind Tunnel, R.A.E., Farnborough
Tannery for Messrs Tremletts, Exeter
Dust Extraction Plant at Animal Medicine Factory for Walter Gregory & Co. Ltd., Wellington, Somerset

ACKNOWLEDGMENTS

We wish to thank all those of our clients who have allowed us to describe in this Brochure some of the installations we have carried out for them. We are specially indebted to the following:

CLIFF QUAY POWER STATION
British Electricity Authority
R. W. Gregory & Partners, Consulting Engineers

BARCLAY SECONDARY MODERN SCHOOL
C. H. Aslin, C.B.E., F.R.I.B.A., Hertfordshire County Architect
Oscar Faber & Partners, Consulting Engineers

C. A. PARSONS & CO. LTD.

ROYAL PORTSMOUTH HOSPITAL
Thomas K. Makins, A.R.I.B.A.

NEW GOVERNMENT OFFICES, WHITEHALL GARDENS
Ministry of Works

SHANKS & CO. LTD.

MURGATROYD'S SALT & CHEMICAL CO. LTD.
Sloan & Lloyd Barnes, Consulting Engineers

BRITISH THOMSON-HOUSTON CO. LTD.

QUEEN VICTORIA HOSPITAL
F. Gordon-Troup, M.I.Struct.E., F.I.A.A.
M. G. Bland & Sons, Consulting Engineers

LEYLAND MOTORS LTD
Harry S. Fairhurst & Sons, F.R.I.B.A.
F. Grimshaw, O.B.E., General Works Engineer

ORGANON LABORATORIES
The A.P.V. Co. Ltd.

GILLETTE INDUSTRIES LTD.

CHARTERHOUSE
Seely & Paget, F./L.R.I.B.A.

CHURCHILL GARDENS
E. J. Edwards, A.R.I.B.A., F.R.I.C.S., Director of Housing, City of Westminster
Kennedy & Donkin, Consulting Engineers

LIVERPOOL CATHEDRAL
Sir Giles Gilbert Scott, O.M., R.A.
The Dean of Liverpool

TRAFALGAR SQUARE FOUNTAINS
Ministry of Works

SHAKESPEARE MEMORIAL THEATRE
Brian O'Rorke, A.R.A., F.R.I.B.A.

SOUTHAMPTON CIVIC CENTRE
J. Roger Preston & Partners, Consulting Engineers

GENERAL ELECTRIC CO. LTD.

PIER APPROACH BATHS
The Baths Superintendent
K. M. B. Cross, M.A., F.R.I.B.A.