

Saving St. Paul's in London

By M. Macartney, F.S.A., Architect in Charge

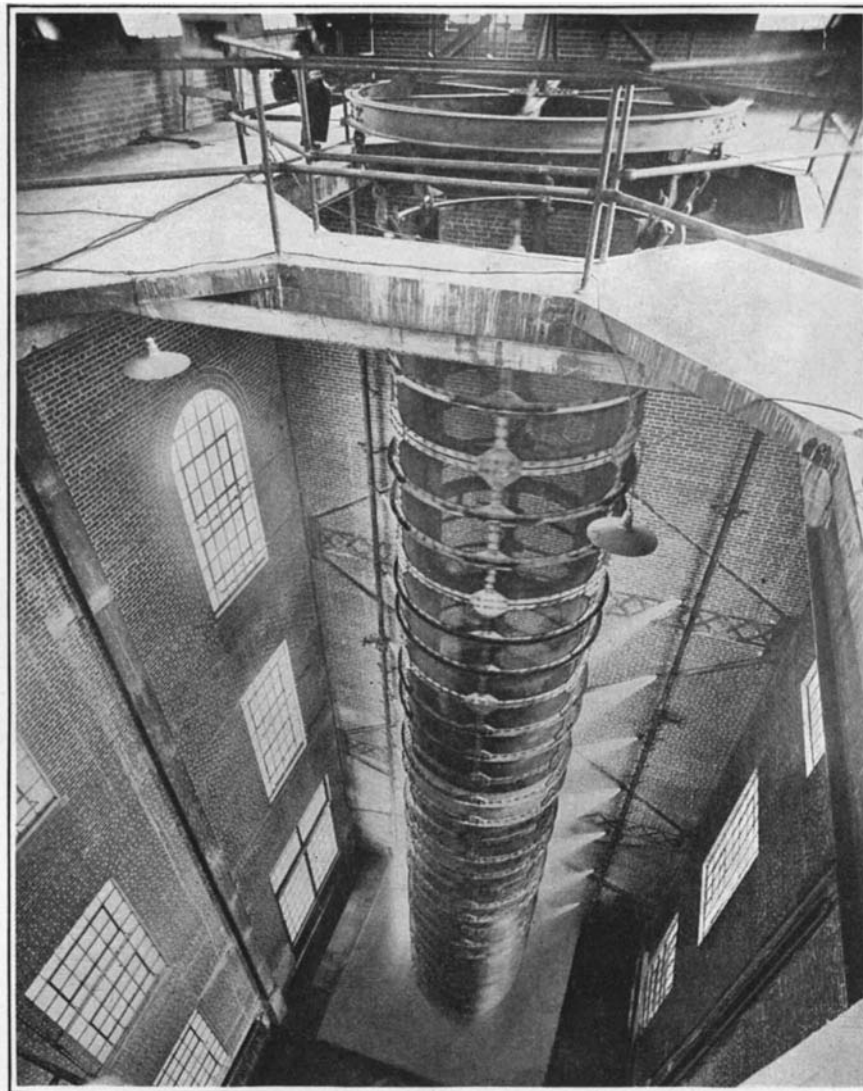
SIR CHRISTOPHER WREN, if the statement in "*Parentalia*" is to be credited, considered the soil that supported the central tower of old St. Paul's to be sufficient to carry his proposed dome. The central tower of old St. Paul's was 50 feet square, and approximately 260 feet high, carrying a lead-covered spire thereon some 250 feet high. Any calculations that one can make at this stage as to the weight of the old tower and spire must be very rough indeed, but the weight of a Gothic structure of the kind is, as a rule, comparatively light, and it is probable that the soil was not loaded so heavily as by the supports of Wren's dome. The present dome weighs approximately 60,000 tons, which is carried by 8 main piers, the area of the foundation of each of which is approximately 1400 square feet. This gives a pressure on the soil of approximately $5\frac{1}{2}$ tons per square foot. The foundations are based upon the same layer of clay, or so-called "pot earth," as that upon which the old cathedral was founded. This clay should be able safely to withstand the load, though in planning a new building today, one would not probably put a pressure of more than 3 to 4 tons a foot thereon, in order to avoid undue compression and settlement. The area of the Cathedral is adequately drained, but there is water in the sand beneath the layer of pot earth about 13 feet below, which keeps the clay damp. Since the building was completed there are no special signs of settlement of the foundations, and certainly no movements have been noticed since close observation has been given to the matter in the last quarter of a century. The water level in the subsoil seems to remain fairly constant, and so long as it is not completely drained the clay will probably retain its present consistency. To underpin the foundations down to the London clay some 24 feet below would be a very difficult enterprise, and extremely costly, and would hardly be warranted.

Next to the quality of the foundations comes the construction of the piers. It seems strange that Sir Christopher Wren, after severely criticising the methods of the mediæval architects, should have adopted a similar system: that is, a facing of wrought stone filled with rubble in lime mortar. The natural result followed; that is, the core of rubble and lime contracted as it dried and was compressed by the increasing weight of the superstructure of the building, thus throwing an undue stress upon the casing. I may here interpolate the remark that for many years the book "*Parentalia*" has been regarded as an authoritative

source of information about Wren and St. Paul's. It was published by Stephen Wren in 1750, and contains a picturesque account of his grandfather's works, founded on material by his father Christopher Wren, the younger son of the great Sir Christopher.

When one is able to test the accuracy of this work, however, it is generally found to be untrustworthy; so much so that unless a statement is corroborated by collateral evidence it cannot be accepted as true. Therefore, the assertion that the settlement of the southwest pier was due to the unequal temper of the soil may or may not be the fact, especially when we find from the accounts that a considerable amount of

(Continued on page 123)



One of the gigantic cylindrical screens that keep the river debris out of the water used in Louisville's power station, raised and being cleaned

Clean Water for the Power Plant

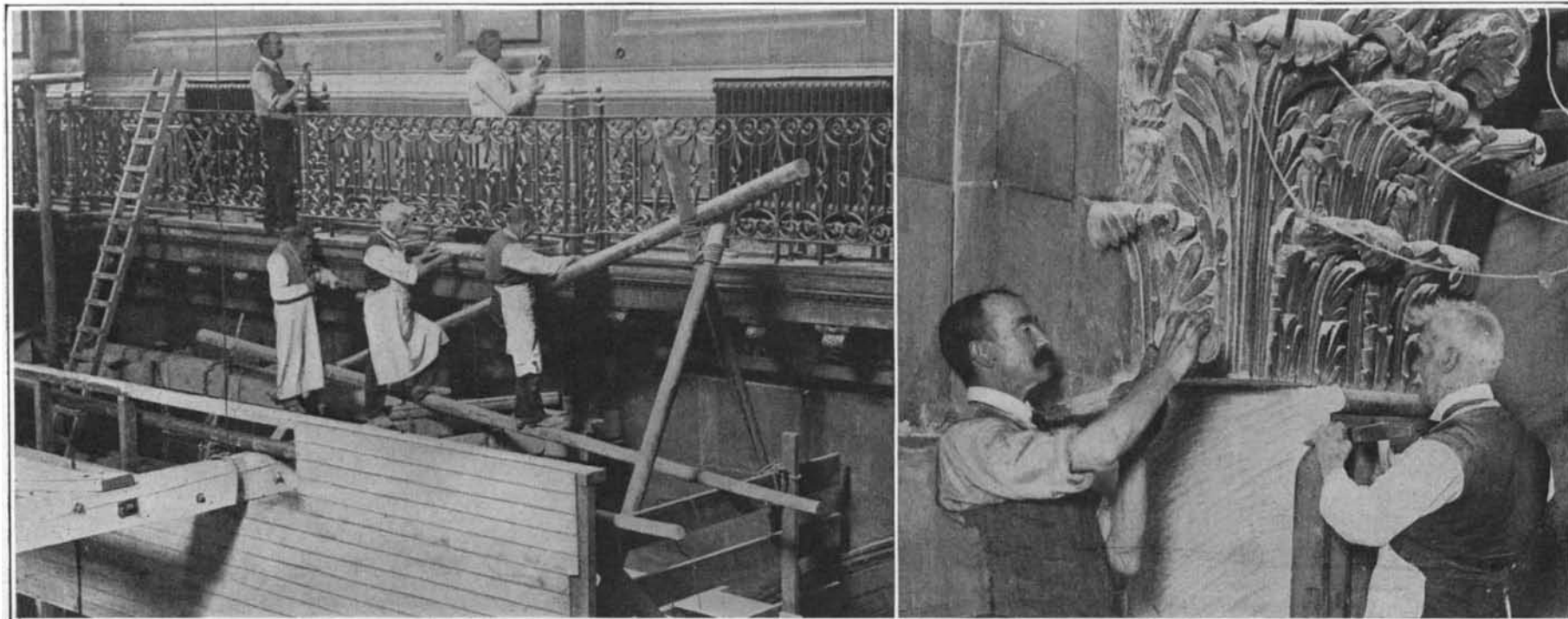
By George T. Holmes

LEAVES and twigs that float in rivers and lakes have created a problem that has long puzzled engineers of gas and electric generating stations in our inland cities. This debris although apparently insignificant in size is able to clog up almost any sort of screen now in use in such plants for straining the river water used in the turbines and condensers. Until recently the only sort of screening device has been a vertical screen or set of screens; but with these it has become practically impossible to raise the screens for cleaning in the face of the pressure of the water against the lower section of the screens, which gets clogged into a solid wall of mud and leaves.

Engineers of the Louisville lighting company have discovered a better method than the vertical screen process and point out its beneficial results to other engineers confronting the same problem. The device is a duplicate set of three concentric cylindrical screens sixty feet high and about ten feet in diameter. Each set is capable of supplying sufficient water to run the plant, but the duplicate was installed a few months ago to have ready for use in case of any possible mishap. The screens are raised in a tower 120 feet high and cleaned one at a time. While one screen is in the air, the water is strained through the other two, so that at no time are there less than two screens in use.

Conditions at Louisville probably are typical of those prevailing at most of the towns which take condensing water from inland streams. The river rises and falls through about forty feet. The Ohio drains a water shed which becomes covered with leaves, weeds, etc., every fall. This rubbish does not come down regularly or gradually, but comes with the freshets, and unless screening equipment is ample and designed for ready cleaning it will become foul and fail to pass sufficient water. To make matters worse, the clogging of the screens causes them to act as dams, lowering the water on one side and keeping it up on the other, so that the pressure against the screens, the flat kind being in use, frequently makes it impossible to move them, necessitating often a complete closing down.

The equipment now in use in Louisville consists essentially of three cylinders of wire netting, set concentric in a deep well. The water comes up through the floor which carries the screens, into the center of the smallest screen. It flows outward through all three screens, which can be raised and lowered separately for cleaning purposes.



Repairing old St. Paul's Church in London. Left: Making the preliminary examination of the structure. Right: Pouring liquid cement into a crack

Railroading Under Roof

(Continued from page 112)

ing received the staff entitling him to possession of the block releases the brakes and proceeds. A skilful and almost continuous use of the brakes is required to keep within the passenger train speed limit of 28 miles an hour. Several times during the coast down the mountain the train stops for about five minutes to allow the wheels to cool.

For freight trains still greater precautions are necessary. The head engineer on west-bound freights applies the brakes and stops a little more than a train length after leaving Tunnel No. 6 which is on the east side of the Summit. If he did not stop he would run through a siding, out of the sheds and on to the ground; for the switch is always set for the siding and must be thrown by the head brakeman. After the helper is cut off the engineer charges the train, following which all retaining valves are turned up. Then the air is tried by opening the angle cock at the rear of the caboose which sets all the brakes.

If all is well the brakes release and the engineer, having received the staff, proceeds without waiting for a signal from the rear of the train for the excellent reason that no signal could be given. All communication between front and rear of the train is entirely cut off while the train is in the shed and all usual methods of operation are abandoned. The flagman hangs a Dietz lantern under the rear platform close to the track and stations himself on the platform where he keeps a close watch of the track. If he sees ties freshly splintered he knows a car is off, so he opens the emergency valve and stops the train.

So long as the lights at the entrance to each block are both green the engineer keeps going, exchanging staffs by means of a staff catcher at the side of the cab. But if the home signal is red and the distant signal is yellow he retains his staff and enters the siding. There being no way to get a signal from the rear of the train the engineer watches the signs on the side of the shed which are numbered "20," "25," "30," and so on until he is opposite the number corresponding to the number of cars in his train, when he knows he is in to clear, so he stops and stays until the opposing trains pass.

Six times during the descent of the mountain the train halts while the train is inspected as the wheels are cooling. A man on each side passes along the length of the train looking for brake beams down, cracked or broken wheels and noting the temperature of the wheels. If a car has wheels too warm the retainer is turned down to give the wheels a rest except when the engineer holds the brakes on. If a car has hot wheels the brake-piston travel and the brake rigging are investigated to see if the brake shoes are being held against the wheels. Often the wheels are hot enough to burn the fingers; sometimes they are red hot; sometimes they get hot enough to burst. But sometimes they are so cool they show that the cars are not doing their share of holding the train.

Two Wompuses are assigned to a fruit "block" of 45 cars east bound, the helper being placed ten cars from the rear end. In the sheds not even the usual whistle signals between lead engine and helper can be exchanged, for whistle signals cannot be heard. So when a train pulls in on a siding the head engineer releases his brakes and lets the slack run back on the helper who sets his independent driver brakes as soon as he comes to a stop. When the lead engineer is ready to go he sets the brakes with a heavy reduction, then releases. The engineer on the helper takes the release as a signal to go, releases his independent driver brakes and begins to work steam.

The engineer cannot even get a signal from the fireman in taking water in the

sheds. Instead he stops at a mark opposite his window. All flagging is done by torpedoes. Section men and bridge carpenters, who are constantly at work in the sheds put out torpedoes on each side. The roar in the sheds is so great that even torpedoes cannot always be heard, but a well-trained nose can smell them. The engineer also depends on his sense of smell to warn him that drivers are slipping, otherwise he might never know it. In the same way the engineer detects hot boxes.

His sense of touch guides the engineer in the use of throttle and brake valve. He has no means of knowing whether the injector is working except by feeling the supply pipe; for if he put his head out of the window to look at the waste pipe he would get it knocked off.

A break-in-two in the sheds means a delay of an hour to two hours. A man has to walk over the train for he cannot walk beside it in winter, to find out what is wrong. Then he has to walk to the caboose, hoist a chain to the top of the cars, drag it along to the break, walk over the top to the engine, tell the engineer exactly how far to back up, chain the break together, then walk to the engine once more to tell the engineer to go ahead, for there is no possibility of passing signals.

Saving St. Paul's in London

(Continued from page 113)

repairs of the southwest and southeast piers took place owing to crushing of the stone casing.

The building itself gives us the best indications of what happens. We find that the impost molding in the crypt has a 3-inch band of stone underneath it, which is a pretty sure indication that the pier sank that much before the impost was placed in its present position.

We are face to face with certain facts. First, the masonry of the piers has been crushed. Second, the agglomerate of the piers is not as good as it should be. Third, to whatever cause it may be due, the piers have settled. Therefore, our best course is to make the piers as sound as we can, and, like Wren, trust the foundations to keep up the present fabric as it did its predecessor. This, then, is our present endeavor. We cut out stone by stone the crushed masonry, and reinsert sound, using every care not to remove too much at a time. That so far we have been successful is a tribute to the vigilance of the workmen and the efficient supervision of the contractors. The first pier (southwest) has been practically renewed without an appreciable crack being visible. We are now treating the southeast pier in the same way. After we have inserted the new stone we endeavor to consolidate the rubble as far as possible by pouring in liquid grout by gravitation. As a safeguard against any unforeseen settlement, we are erecting a steel center under the South Transept Arch to pick up the weight should any failure of this work take place.

Getting the Rest of the Oil

(Continued from page 114)

rock in its structure. Therefore, it is practicable to duplicate in miniature the several strata that influence directly the underground migrations of oil, water, and gas when man disturbs nature's subterranean equilibrium.

The heavy face plate of the tank permits the experimenter to watch the changes promoted by the application of the forces and by the introduction of fluids at his disposal. Again, when the test covers an interval of some hours, for example, photographic records can be made at prescribed intervals. In this way are obtained data which can be examined at leisure. Facts of importance are thus brought to light which might escape observation during the shifting of the masses. It should be mentioned here that

the Mills apparatus is large enough to allow the investigations to be conducted on a scale of sufficient magnitude to avoid any misleading effects of capillarity. By using sands that are more or less saturated with oil and water, the capillary forces at work are far weaker than the other ones that are deliberately called into action by the investigator; and the latter are subject of his immediate inquiry. It should be understood, of course, that the experimental tanks can be carried to laboratories situated in the oil fields, and there employed agreeably to the geological conditions disclosed by the driller's log and other information obtained during the operation of a well or group of wells.


It has for many years been suspected that the migration of oil under ground, once man destroyed the balance of the pent-up energy, might cause the petroleum to be trapped so that it could not be drawn surfaceward by the pumps of existing wells; and, similarly, it was believed that a lack of understanding on the part of the operator led all too often to movements below ground that would shorten to a greater or lesser extent the profitable productive life of a well or wells. Mr. Mills has confirmed these assumptions and his tanks give visible evidence of much suggestive value.

He has made it clear that, with suitable information available, it is possible to adopt preventive measures that may be counted upon to check or correct subterranean water troubles that have interfered or threatened to interfere with a well's yield of oil, and thus to prolong to a marked degree the life of that well and, perhaps, of a wide neighboring area. Again, in a kindred way, his tests disclose how the "nursing" of the natural gas associated with a given pool arresting its untimely escape, may serve to drive the oil to the shot holes or pump intakes, and eventually bring about the extraction of a far larger percentage of the petroleum than might otherwise be feasible. And then, the apparatus has revealed how compressed air, forced down from the surface, may be relied upon to take the place of the vanished natural gas in promoting the recovery of oil. Finally, if time be allowed for the disturbed or remaining fluids to readjust themselves, it seems that the oil may assume another position which may aid its extraction. In other words, intermittent pumping of a well may give better results than continuous operation; and even apparently exhausted wells, in some circumstances, may be found productive after a period of inaction.

Enemies of Timber Construction

(Continued from page 118)

Atlantic and Pacific coasts of America and the coasts of Europe. The *chelura* is another diminutive enemy of submerged construction in salt water. It occurs in great swarms and the mode of attack is similar to that of the limnoria. Common names are sea fleas and red-wood lice. The *sphaeroma* is yet another shell animal. It resembles the limnoria, but has a rounded instead of a flattened body. It is a little bigger, excavating a burrow with a diameter of $\frac{1}{8}$ to $\frac{3}{16}$ inch and a depth of $\frac{1}{8}$ to $\frac{1}{4}$ inch. It is less common than the limnoria, but infests fresh as well as salt water. The *martesia* is still another enemy of marine construction. When the *martesia* enters a timber, the perforation will be only about $\frac{1}{8}$ inch in diameter; but the burrow inside may reach a diameter of 1 inch. It is thought that the burrow is not excavated for food but for use as a retreat. The head is bivalvular. It is pretty much the whole affair. When operating upon a timber, the head opens and a hard and rough tongue begins action. As it works back and forth, the hole is cut. The *martesia* does not seem particular as to the material into which it bores. Tar



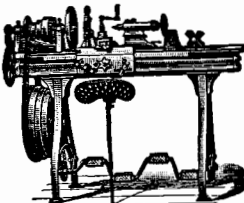
Wherever the problem of Indicating, Recording or Controlling the heat factor in modern industrial process work has been solved successfully, there you will find Tycos Temperature Instruments. The reason—unquestioned utility, reliability and permanency.

A carefully compiled catalogue, valuable as reference because prepared from your point of view, will be sent on request.

Taylor Instrument Companies
Rochester, N. Y.

There's a Tycos or Taylor Temperature Instrument for Every Purpose

For Gunsmiths, Tool Makers, Experimental & Repair Work, etc.



From 9-in. to 18-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.

W. F. & J. Barnes Co.
Established 1872.
1999 Ruby Street
Rockford, Ill.

1/4 H. P., 110 volts, A. C., 60 cycle, single phase, 1750 R. P. M.

MOTORS

LARGE QUANTITIES NEW WASHING MACHINE MOTORS

These are of standard manufacture and carry the full factory guarantee. Shipped in original boxes. Complete as sent. Suitable for operating Coffee Grinders, Cream Separators, Bottle Washers, Air Compressors, Small Lathes, Etc.

Mail \$1.00 check or money order. We will send C.O.D. subject to full examination. Money Ref. Guaranteed.

\$22.75 Each

MANUFACTURER'S DISTRIBUTOR

CHAS. H. JOHNSTON - Box 21 - W. E., Pittsburgh, Pa.



POWER BENDERS

Two New Models "Wonder" Cold Pipe Bending Machines (Pat.) electrically operated to bend from 1 in. to 8 ins. Send for plated matter. We also manufacture TEN other sizes, hand operated to bend from 1-8 inch to 6 inches.

American Pipe Bending Machine Co.
Manufacturers

32 Pearl St., Boston, Mass., U.S.A.





Over 200,000 Now in Use

A Wonderful Small Power Unit

The most powerful gas engine, inch for inch, ever built. Compact—efficient. Only three moving parts.

Maytag

Multi-Motor Gas Engine

1/2 H.P. and 1 H.P. Sizes

Air cooled. Equipped for battery or magneto ignition. Easy to start. Uses either gas or gasoline. Absolutely dependable. Comes in 1 H. P. and 1/2 H. P. sizes. Write us for details. Tell us your power needs. Special prices to quantity users.

THE MAYTAG COMPANY
Dept. Z
NEWTON, IOWA