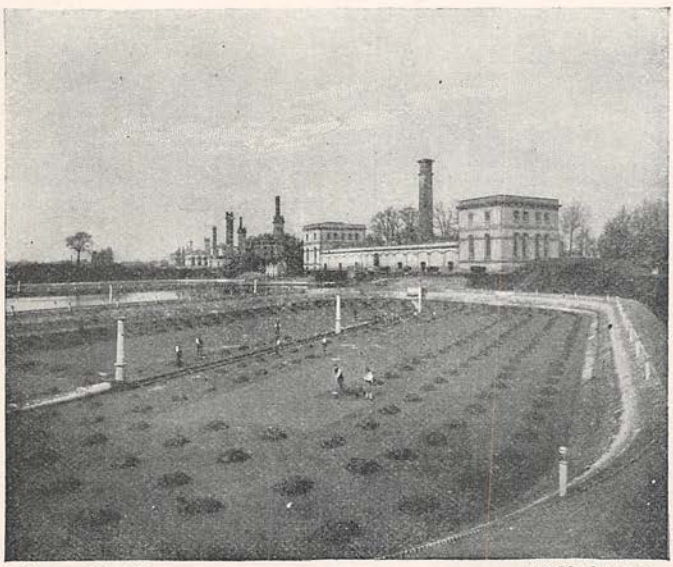
HOW LONDON IS SUPPLIED WITH WATER.

By Frederick T. Souden.

ON the south-east slope of the Cotswold Hills there is a tiny bubbling streamlet which experiences in its course all the changes of Tennyson's brook, and particularly its mimic impetuosity. You look down upon what a child's mud-dam would seem able to divert from its channel, and if you are interested in the beginnings of things, you probably reflect that here, and not some 250 miles away, is the origin of a city whose equal has never yet risen, and of a commerce which rides upon every sea. You may go a step further, and consider also that this ineffectual-looking rivulet gives birth to the greatest and most complete water supply known to the ancient or the modern world—a water supply which spreads out an underground network of many hundreds—nay, thousands—of miles, from the huge trunk main, through which a man could conveniently crawl, to the diminutive half-inch direct delivery pipe. It is usual to think of the Thames as slowly broadening down from the few feet at its spring sources to the eight hundred yards at Gravesend. There is another aspect of it which, considering the vast quantities drawn from the river, is equally correct. It is that in form resembling a Japanese fan, of which the stem is the river to Hampton, and the lateral extensions the south-western and western districts, curving first outwards, then around, and finally embracing the whole of the Metropolis on both sides of the river. Roughly speaking, the ribs of this giant fan are the great trunk mains, tapped at irregular distances by the subsidiary or street mains, and thence pierced at much lesser intervals by the pipes which constitute the inlets to the three-quarters of a million houses fed from the national river.



From a photo by] [*Bedford Lemere.*

FILTERING BED AT THE HAMPTON WORKS OF THE SOUTHWARK AND VAUXHALL WATER COMPANY.

The water supply to some five and a half million persons is in the hands of eight companies. The New River and the East London obtain theirs chiefly from the Lea, which rises in Hertfordshire and joins the Thames at Blackwall, and, to a less extent, from deep wells sunk in the chalk along the Lea valley. The East London has also the right to abstract ten million gallons daily from the Thames at Sunbury. The Chelsea, Grand Junction, Lambeth, Southwark and Vauxhall, and West Middlesex, derive their supplies from the Thames in the neighbourhood of Hampton. The Kent company, however, pumps the whole of its water from deep wells sunk in the chalk. As, with the exception of the last named, the several companies employ practically the same methods of pumping, storage, filtration, and distribution, it will be unnecessary to select more than one to represent the whole.

Visitors for the first time to Hampton must often have wonderingly inquired the meaning of those tall, gaunt buildings, with taller, massive towers, extending far away

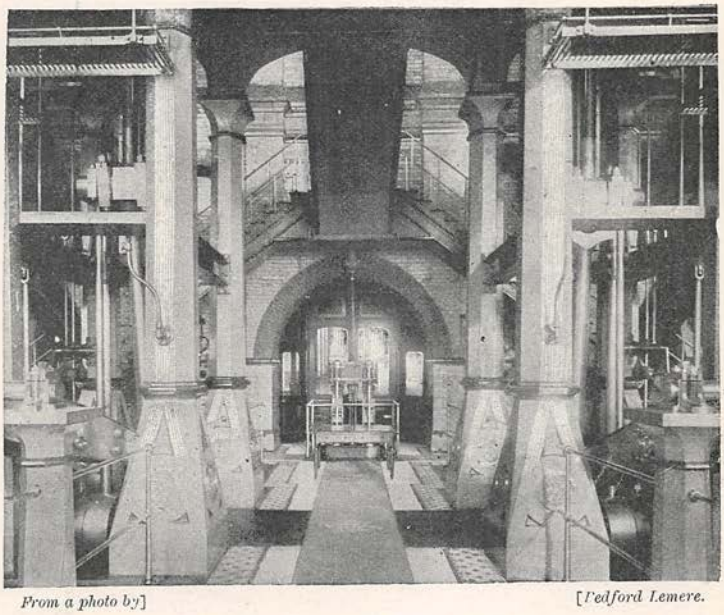
along the river bank, seemingly silent, no human life visible about them, and strikingly incongruous in that soft, pastoral scene. Prosaic enough, truly, to the ordinary person, will appear their functions when told that they are merely pumping stations; yet it should hardly need the "scientific imagination" to invest them with a little, at least, of the glory and the romance of the conquest of mind over the most potent of natural forces. Conceive that daily—that is, all day and all night long—some 120,000,000 gallons, or one-eleventh of the average flow of the non-tidal Thames, is being lifted bodily scores of feet, swept many miles along cavernous mains which empty into a vast acreage of reservoirs; are again raised by machinery and sent travelling as before; with the process renewed from point to point, till levels, hundreds of feet above the river longitudinally, are reached, and the life-giving streams are poured over an occupied area of no less than 620 square miles. The feet of London's millions are, indeed, tramping above these full-flowing arteries and veins at practically every step they take.

From a photo by] [*Russell.*

MR. WALTER HUNTER.

(*Engineering Director to the Grand Junction Waterworks Company.*)

The Grand Junction Waterworks Company, which is a good type of the rest, has four stations—at Hampton, at Kew Bridge, at Campden Hill, and at Ealing. There are two inlets at Hampton. The lower one, alongside the Southwark and Vauxhall Company's Works, is used for charging the low-level filters wherewith to supply the wants of the country district. The other inlet, about three-quarters of a mile further up, it will be necessary to describe a little more fully, but not, I hope, too technically for the general reader. The intake chamber is upon an islet, and is constructed of brickwork, in which the sluices are built for the purpose of regulating the quantity of water drawn from the river. Along the front of the sluices is fixed a coarse screen, preventing floating pieces of wood and leaves from entering the pipes. The chamber is built high enough to keep out flood water, which sometimes rises eleven feet above ordinary summer level. The water is conducted by 36-inch and 30-inch pipes to engine wells about half a mile distant. Upon a piece of land immediately opposite the inlet, drain pipes, with open joints, have been laid for the purpose of intercepting water running down to the river through the gravel soil, which forms the upper stratum in this locality. An open channel has been constructed along the centre line of this land, having a pipe commanded by a valve, which enables it when necessary to be charged from the river. The



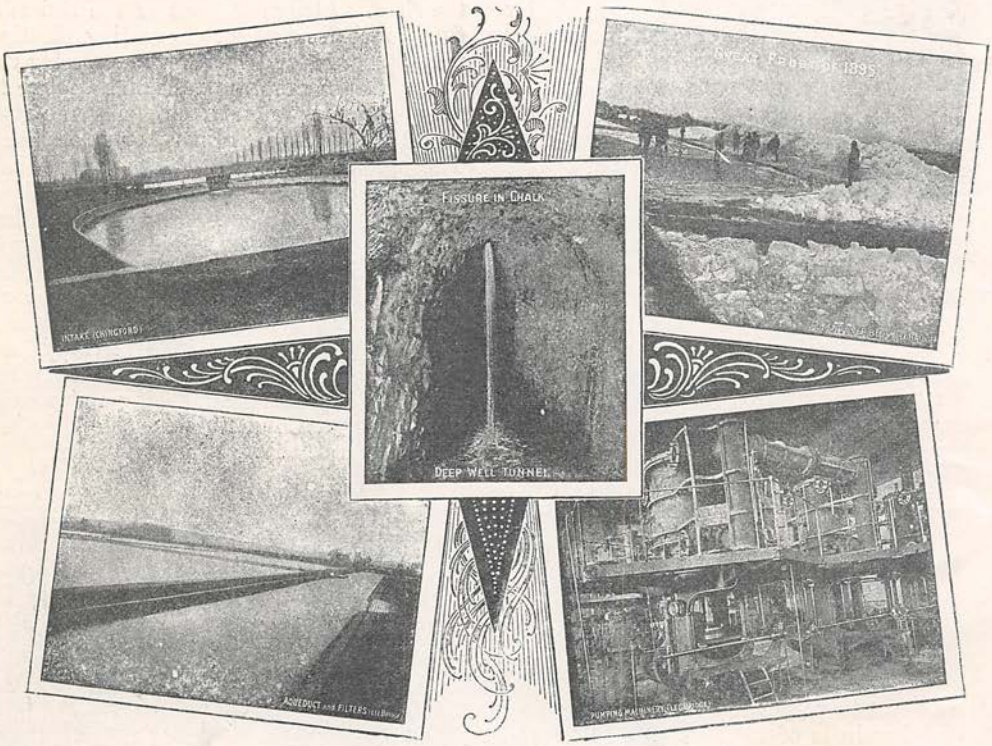
From a photo by] [*Vedford Lemere.*

PUMPING ENGINE AT THE HAMPTON WORKS OF THE SOUTHWARK AND VAUXHALL WATER COMPANY.

water then percolates through the gravel soil to the open-jointed drain pipes before named, passes to another 30-inch pipe extending to the works, and thence to the pump well of a pair of horizontal engines. This water, it will be observed, has passed through a natural filter and is certainly brighter and cleaner than the ordinary river water when the river is in flood.

And the engines—the mechanical heart of this intricate yet leviathan system—so huge are they that the men who control them are dwarfed even by their minor parts. Some of the most powerful machinery manufactured is here—that piston-rod, for instance, whose throb sets up a pulse that beats twenty miles away, or those glancing steel arms conveying a sense of irresistible power applied without effort. There is the centrifugal engine of a capacity of about eleven million gallons a day pumping water direct from the engine well on to the filter beds. Close by are a pair of compound Riedler engines capable of pumping fourteen million gallons daily from the engine wells into subsidence reservoirs, or direct on to the filters. Again, we have a pair of compound high-lift Riedler engines for pumping fourteen million gallons of water partly filtered and partly drawn from the river to the Kew works. Finally, there is a triple-expansion Worthington engine assisting in the pumping to Kew. One gets an idea of the immense mechanical forces brought into play in this otherwise quiet spot by remembering that in each of these great rectangular buildings, that form such an imposing line along the river front at Hampton, similar work is going on by similarly applied energy.

It is time to say something of filtration, for a waterworks engineer recognises this as the most responsible and exacting part of his office. All water derived from rivers and mountain streams requires to be filtered. The latest type of this agent may be thus described. The side walls are formed of concrete, faced with blue bricks and provided with a puddle backing to keep out other surface water. A charging channel is formed at the side of each filter into which the water is delivered and whence it flows in a stream of even depth over the whole surface of the filter. The lowest stratum of filtering material, resting on a six-inch bottom of Portland cement



EAST LONDON WATERWORKS COMPANY.

concrete, consists of stones about two inches in diameter. Upon these is placed a layer of fine gravel. Above this is a stratum of sand, which is the real filtering medium. The water in flowing through this sand leaves on the surface a thin deposit which has been found highly effective for eliminating microbes. The concrete floor, it should be said, slopes from either side to a culvert running along the centre, whence the water passes into a main conduit connected with the filtered water wells of the distributing pumping engines. Everyone is familiar with the pictorial view of "a drop of London water magnified." Investigations in bacteriology have shown the necessity of excluding the lively, but, to the naked eye, invisible microbe. This is attained by the use of a finer sand, though it has the drawback of holding up the water longer and necessitating the construction of a larger area of filter beds per million gallons of supply. The public, however, are adequately protected. Sir E. Frankland, K.C.B., acting under the Local Government Board, tests water both bacteriologically and chemically, and publishes a monthly return of the results. Sir William Crookes, F. R. S., and Professor Dewar, F.R.S., on behalf of the water companies, make similar examinations daily.

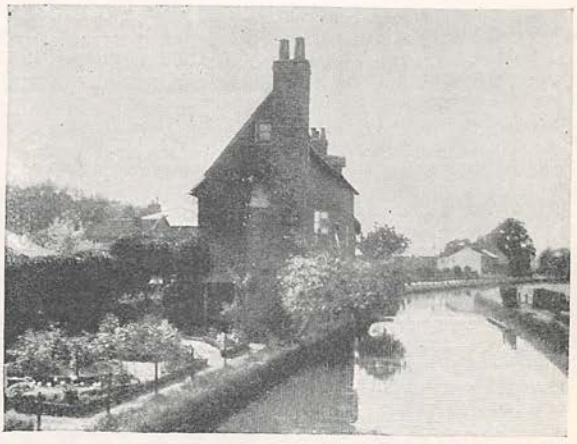
From a photo by] *[Elliott & Fry.*

MR. JOSEPH FRANCIS.

(*Engineer to the New River Company.*)

The Maidstone epidemic, and one or two circumstances somewhat trifling in their real nature, but acquiring a lurid prominence in the glare of that unhappy event, have led to a revival of the old questionings as to the purity of London water. It is well to recall to mind what Lord Balfour's Royal Commission of 1892–3 reported (paragraph 178):

"We are strongly of opinion that the water as supplied to the consumer in London is of a very high standard of excellence and purity, and that it is suitable in quality for all household purposes." Since then some material improvements in the processes for purifying water have been applied, so that what was true five years ago is, if possible, still more true to-day.



RED HOUSE, WARE, ON THE CANAL.

An important development of the present supply system remains to be noted. Every recurring summer there is a more or less violent outcry against the restrictions in the service imposed by the companies which supply the more congested parts of the Metropolis. When the season is particularly dry there arises, in the language of the newspapers, a "water famine." Nor is it possible to deny that much danger to health and not a little suffering has been caused in

From a photo by] *[Maull & Fox.*

MR. J. W. RESTLER.

(*Engineer to the Southwark and Vauxhall Waterworks Company.*)

seasons of partial drought. To obviate these evils a gigantic scheme of storage was proposed to the Royal Commission by Mr. Walter Hunter, M.In.C.E., the engineering director of the Grand Junction, and the late Mr. Alexander Fraser, M.In.C.E., then engineer of the company. This was to be effected by the construction of reservoirs on suitable land near Staines. Into these, when there was an ample supply in the river, the surplus water was to be pumped, and sent into the service mains when the quantity of water passing down the river was small. The scheme as to the quantity of storage was based upon the requirements of the Thames Conservancy that the minimum flow at Teddington Weir should not fall below two hundred million gallons daily. This condition in dry seasons cannot be absolutely maintained unless all the Thames water companies are compelled to join in a scheme of storage. It is possible that this will some day be attained by legislation.

From a photo by [*Lavender.*

MR. WILLIAM MORRIS.
(*Chief Engineer of the Kent Waterworks.*)

Meanwhile, the West Middlesex, Grand Junction, and New River companies have obtained from Parliament the "Staines Reservoirs Act," under which they have undertaken to provide sufficient storage to justify the abstraction, together, of thirty-five million gallons daily, or, upon emergency, by consent of the Board of Trade, forty-five million gallons daily. The total quantity to be drawn from the river is limited to a hundred million gallons a day, both for supply and storage, and the water thus abstracted must be taken out of the surplus above three hundred million gallons flowing at Penton Hook, which is equivalent to about 220 million gallons flowing at Teddington after the companies have taken their statutory quantity at Sunbury and Hampton.

From a photo by [*Russell.*

MR. M. W. HERVEY.
(*Engineer of the West Middlesex Waterworks.*)

From a photo by [*Harman, Bromley.*

MR. WILLIAM B. BRYAN.
(*Engineer to the East London Waterworks Company.*)

It should be added that already the surveys have been made, the working drawings completed, and the works, for which there is an authorised capital of a million, commenced. The joint engineers to the scheme are Mr. Walter Hunter, M.Inst.C.E., and Mr. R. E. Middleton, M.Inst.C.E.

In opposition to the storage principle there are many advocates of a supply direct from Wales. It has been estimated, however, that to give practical effect to a proposal of this kind would require the colossal sum of £38,000,000.

One great advantage of the Staines scheme is that it can be carried out by instalments, as proved to be necessary by the growth of the population. The Welsh scheme, on the other hand, would require an immediate expenditure of probably £20,000,000, which would earn no return for many years to come.

As indicating the extent of the present water supply industry, it may be stated that the combined companies represent a capital of between £33,000,000 and £35,000,000.