south. Such traps, to be efficient, must be so placed that they can be examined from time to time. They must be of good proportions, and they are rather expensive affairs. We happen to know that in many instances where they have been fitted they have had to be removed, because they caused more trouble and nuisance than they were worth. If care were taken to provide 3in. seals to the sinks and closets of a dwelling house, with proper ventilating pipes, then would the external trap be wholly unnecessary. But let us suppose that the system were universally adopted; we should then have the main sewer cut off from the stack pipes. Would matters be improved? We much doubt it. The gas would then rise through the street ventilators in greater volumes than ever, and flow over the roadway and into the houses. That these ventilators are dangerous nuisances is known to most sanitary engineers; and various devices, in the shape of charcoal baskets, have been adopted to render them harmless. In many cases these have proved useful, but Sir Joseph Bazalgette at all events has pronounced them worse than useless, and they are not now fitted in London. When a complaint is brought before the local authorities that a street ventilator is causing a nuisance, a man is sent with a bucket of disinfectant, which is emptied down the ventilator, and the authorities rejoice that they have done all that is needful for the well-being of the community.

We may be asked, what would we have? Ought street ventilators to be done away, and if so how are drains to be ventilated? To this we reply that some years ago the ventilation of town drains constituted a subject of constant discussion among sanitary engineers, while now hardly anything is said about it. Are we to assume that the difficulties to be encountered are too great to be overcome? We think not, and we write in the hope that the subject will once more receive the attention it really deserves. May we venture to suggest that the best way of ventilating a sewer would consist in taking a lesson from the performance in this connection of stack pipes, and developing the idea in a practical shape? As, for example, let it be made compulsory on every builder to carry up a flue through one of the walls of his house, the top of which flue may be made to assume the form of an ordinary blind chimney cap; this flue should freely communicate at its base with the main sewer, either by means of the common drain from the house, or by means of a subsidiary drain. The best position for the flue would be alongside the kitchen chimney, from which it would constantly derive heat. The result would be at all times a strong—for a sewer ventilator—upward current through the drain flue, which would discharge the sewer gas through an aperture in its side, where it ought to do no harm—at an elevation, at least, far safer than that to which any stack pipe reaches. The cost of the arrangement would be very trifling, and it could be adopted under every conceivable circumstance. When small houses are built in a group, one or two ventilating flues only would suffice, instead of one for each house. Of course all street ventilators would be closed up.

THE EDISON ELECTRIC LIGHT.

Details are leaking out respecting the Edison light. The *Scientific American* has the following description of it:—"It is based on the well-known fact that a wire may be heated by an electric current, the basis of many attempts to accomplish what Mr. Edison claims to have done. The reader may have seen the gas jets of the dome of the Capitol at Washington lighted by similar means. Over each burner is placed a coil of platinum wire, which, when heated by the electric current, ignites the gas. Mr. Edison uses the coil itself as the source of light, the current sent through it being strong enough to make the coil white hot, or self luminous. The difficulty to be overcome at this point was the liability of the wire to fuse and spoil the light; a difficulty which Mr. Edison claims to have obviated by the introduction of a simple device which, by the expansion of a small bar the instant the heat of the coil approaches the fusing point of platinum, interposes a check to the flow of the current through the coil. This automatic arrangement, in connection with an auxiliary resistance coil, secures, it is said, an even flow of electricity through the coil, and consequently a steady glow of pure light. If this is done economically it is obvious that a marked advance has been made in artificial illumination." It may be interesting to show the progress of invention towards the point which Mr. Edison is now alleged to have attained. In 1845, King patented a lamp in which incandescent platinum wire was used to give the light. The platinum did not work well, and in 1849 Petrie used iridium, which answered very well. In 1873 Lodyguine invented a lamp, improved on by Konn, in which carbon, shut up in a vacuum tube, was used; but the waste of the carbon interfered with the success of the light. M. Bouileguine introduced an automatic arrangement by which the moment the carbon was on the point of breaking it was renewed. In 1854 MM. Lacassagne and Thiers patented a mechanical automatic arrangement by which the combustion of an incandescent platinum wire or tape was prevented. This was applied to a lamp invented by M. Changy and used with success. It does not, of course, follow that because all these stages have been advanced by prior patentees that Mr. Edison may not have the material of a perfectly valid patent. It may be that his apparatus is built up of old matter and may yet be perfectly new and very valuable as a whole. It may be that Mr. Edison has adopted a modification of his Tasimeter as a current governor.

A REMARKABLE BOILER EXPLOSION.

Boilers have exploded ere now under very strange circumstances, but until very recently no one ever heard of an isolated boiler bursting when there was no fire under it. Mr. Lavington Fletcher's last report to the Manchester Steam Boiler Association contains an account of such an explosion. It occurred on the 4th of September, under the following circumstances:—The boiler was of a patented construction, the novelty consisting in making two internal flues larger at the ends next the smoke-box than at the ends where the gases entered them. The length of the boiler was 20ft., the diameter of the shell 5ft. 6in., and of the internal flue tubes 18in. at the back of the boiler, and 21in. at the front, while the thickness of the plates was $\frac{5}{8}$in. in the flat ends, $\frac{3}{8}$in. in the internal flue tubes, and $\frac{7}{16}$in. in the external shell, excepting at the central plate immediately over the fire, which measured about 6ft. long by 3ft. 6in. wide, and in which the thickness was as much as $\frac{5}{8}$in. The safety valve, with the weight at the end of the lever, gave a blowing-off pressure of 80 lb. on the square inch, but it was stated that the blowing-off pressure at which the boiler was generally worked was much less than this, varying from 45 lb. to 62 lb. The boiler was externally fired, the flames, after passing along the bottom, returning through the flues. The thickness of the furnace plates, coupled with deposit, led to the overheating and undue expansion of the plates, while the thick plate strained the thin ones rivetted to it. The boiler was laid down about two years ago, and Mr. Fletcher states that signs of distress were not long in manifesting themselves. After being at work for a few months, serious leakage commenced in the neighbourhood of the fire bridge, the seams straining and the overlaps gaping open. It was found necessary to put on two patches, and on the 4th of last September the boiler burst, the primary rent occurring at a longitudinal seam of rivets at the right-hand side of the central plate over the fire, measuring $\frac{5}{8}$in. in thickness, where joined on to one measuring $\frac{7}{16}$in. in thickness, the rent taking the line of rivet holes and running through the overlap of the thinner plate of the two. This primary rent extended the entire length of the thick central plate till it met a ring seam of rivets at each end, both of which it followed, running round the boiler circumferentially for a length of about 5ft. 6in., when the plate, being liberated on three sides, was blown outwards by the internal pressure of steam, hinged back, and broken off within about 18in. of the top of the boiler, the unbalanced pressure, consequent on so large an opening, lifting the boiler from its seat, carrying it about 18 yards to the left and reversing it in position. The traverse of the boiler, coupled with the rush of steam and water, brought the buildings above it to the ground and reduced the works to a wreck. The explosion occurred when there was no fire under the boiler. The fire had been drawn some two hours. It is but reasonable to conclude that the pressure of the steam had been gradually subsiding during that time, so that the explosion did not occur when the pressure was at the highest, and thus the finishing touch appears to have been given by the contraction of the plates in cooling. Mr. Fletcher properly points out that this case affords an admirable instance of the folly of adopting thick plates with the idea that they can give strength to an unskilfully-designed boiler worked with bad feed-water. If our readers can call to mind any instances of explosion under similar conditions, we shall be happy to place the facts on record in our pages.

LITERATURE.

Album to the Course of Lectures on Metallurgy at the Central School of Arts and Manufactures of Paris. By S. Jordan, C.E., &c. London: Trübner. Paris: Baudry. 1878.

This handsome work represents a teaching appliance of a kind not in use in this country, and which may be regarded as an improved descendant of the "*lithographe cahiers*" common in French colleges, supposed to be MS. *fac similes* of the heads of the Professor's lectures. The author, whose recent paper on the "Iron-making Resources of France," read before the Iron and Steel Institute at the late Paris meeting, will be familiar to most of our readers, occupies the Chair of Metallurgy at the Ecole Centrale in Paris, besides being connected either as director or adviser with several important ironworks, both in the North and South of France; and has, therefore, combined the work done in his own office with material contributed by other metallurgists in different countries into a very useful series of drawings illustrating the different operations of coke-making, iron manufacture, and its conversion into malleable iron and steel, in a thoroughly complete manner. As the author expressly states in his preface, the work is not, and does not pretend to be, a systematic treatise of iron metallurgy—the text, of not quite 300 pages, would be obviously insufficient for such a purpose; and it has, therefore, been confined to a concise description of the 140 plates, which in an atlas accompany the book, with the addition of numerical data and notes upon the working results, comment or criticism being as a rule avoided. The chief strength of the production, therefore, lies in the plates, and these are, with very few exceptions, of great excellence, being both judiciously selected and admirably drawn. As might be expected, however, from a work prepared chiefly from French sources and for French use, the types selected are not always such as would command approval in this country, and we think that some better representations of English blast furnaces might have been given than the very special example of a South Staffordshire furnace about twenty-five years old, from Dr. Percy's book. There is, indeed, a plan of Mr. Samuelson's furnaces at Newport, but no details of a closed-top English furnace, with a cup and cone charger, pure and simple, is given on a scale of any size. On the other hand, we may consider that the Buttgenbach principle, which appears to be a favourite of the author, has been given rather too freely. The different types of stoves and boilers for utilising furnace gas take up some sixteen plates, which are among the most noticeable, as containing a very large amount of detail. Blowing engines, on the other hand, are not so fully represented, nor could we well expect them to be, this being more a mechanical engineer's than a metallurgist's question, apart from the enormous number of drawings required to illustrate even one pattern properly, if detail is to be attempted. The author has, therefore, done wisely in devoting his space principally to one of the direct-acting high-speed engines, with the blast cylinder above the steam engine, made at Creusot, and which fairly represents the modern practice in Cleveland and other districts, in contradistinction to the monumental old beam engine, with cylinders of 12ft. or 14ft. stroke, formerly in favour.

The section devoted to malleable iron comprises seventy plates, including representations of the Catalan forge—an actual representation of one of these interesting furnaces, with all its picturesque irregularities, and not the polished diagram that usually does duty as such—a Franche Comté forge, also interesting as a careful study of a method formerly largely used, but now, like the Catalan fire, in process of extinction. Puddling furnaces, both of English and French types, and that of Danks, are very fully given, the first being in great part from Truran's book, and representing the older practice of South Wales. Iron-making is considered only in regard to welding and drawing, without reference to section, all consideration of roll grooves, except in the forge train, being omitted. This strikes us as somewhat unfortunate, though probably the subject is thought too special to accord with the design of the work, which, in the first instance, must be regarded as a student's class-book. One particular series of drawings, however, that of a three-high mill for rails and girders, is specially noticeable for its extremely careful execution, and we can scarcely imagine a better exercise for students than a careful reproduction of these drawings, or some of their details, would be. The steel section includes complete drawings of Bessemer plant of the earlier English pattern, with six-ton converter and air furnaces for re-melting, the various applications of Siemen's method to steel-melting, both in pots and in the open hearth, as well as the older Sheffield pot-melting holes, working with coke. The newer forms of revolving gas furnaces—Pernot's, Ponsard's, &c.—are not noticed. This arises from the circumstance that the work in its original form was, as stated in the preface, finished and published in 1874, the English text having only been completed at a later period.

The text has been written by the author with some English assistance, and is certainly creditable as the production of a foreigner. It is not, however, agreeable reading, and we think, while giving the author all the praise due to his gallantry in addressing a foreign audience in a tongue not his own, that he would have been better advised had he made more use of English literary aid in preparing it for the press. Taken as a whole the work must be considered to be of high value, and likely to be a standard book for some years to come. We trust that the author will receive sufficient encouragement for his labour to continue the work by adding to the originals new examples from time to time by way of supplements, so that the work may follow as closely as may be the ever advancing strides of this mighty branch of manufacture. In such supplements, supposing them to be published, it would be very desirable that the publisher should abandon the foolish plan adopted in the present case of creasing the plates down the middle, whereby a not inconveniently large folio is converted into something like a clumsy quarto in shape, which cannot be bound so as to open flat by any average bookbinder's skill. Apart from this error of judgment, the get up of the work is excellent, the lithography, executed at Liège, being specially good. The roughness of the paper on which the plates are printed is an improvement on the smoothness of the French edition, as it gives a character more like that of drawings to the impressions.

THE TORPEDO VESSEL DESTROYER.

By John Ericsson.

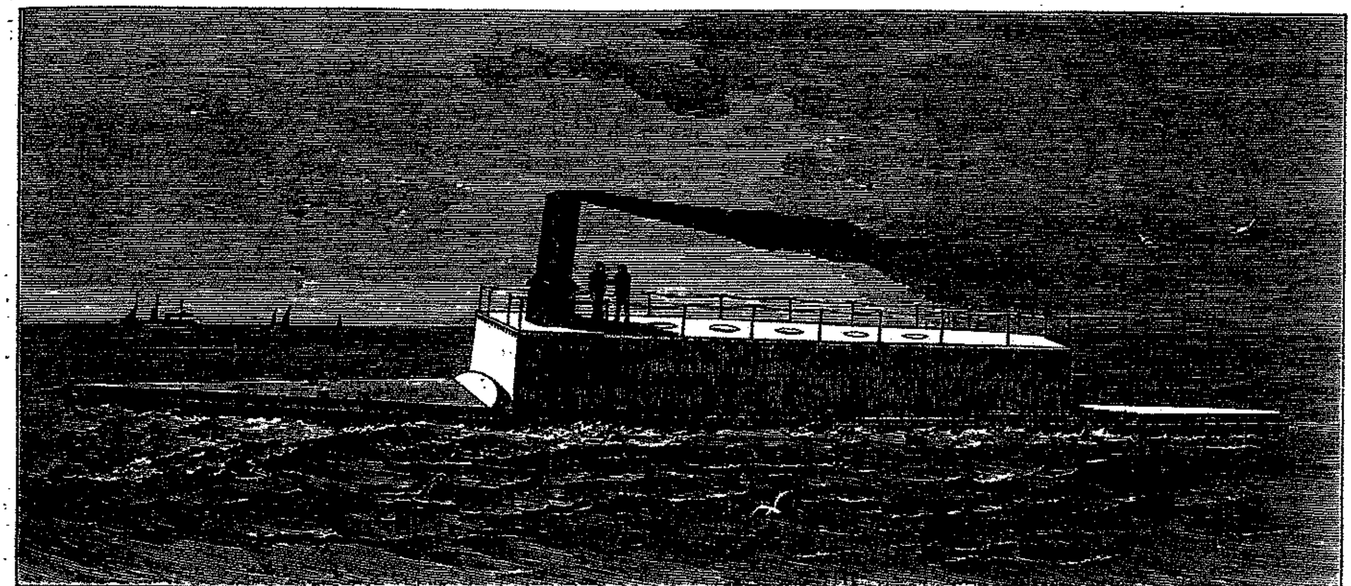
The notice of the Destroyer published in The Engineer of August 30th having called forth numerous inquiries regarding the origin and nature of the torpedo operated by this vessel, I feel called upon to present the following brief reply.

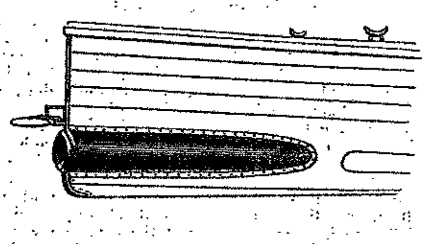
The origin of the projectile torpedo which the Destroyer is intended to discharge dates back to the latter part of 1854, at which time I submitted drawings and descriptions to the Emperor Napoleon III. of a "self-moving vessel, capable of passing within range of guns of forts, and of moving at pleasure in defiance of the fire of broadsides." The leading feature of the plan, apart from the peculiar structure of the vessel, was that of projecting under water by mechanical means, independent of explosive energy, a wooden torpedo 16in. in diameter, 10ft. long, having a 16in. shell inserted at the forward end provided with a percussion lock for igniting the charge by contact, the aft end of the torpedo being pointed in order to facilitate its passage through the water. The method of operating the torpedo was that of inserting it into a horizontal tube near the bottom of the aggressive vessel, provided with valves for keeping out the sea during the process of insertion. When near the vessel attacked, the valve excluding the sea was opened, and the torpedo expelled by a piston actuated by steam power, the expulsion being effected, as before stated, without recourse to gunpowder or other explosive agent. It merits special mention that the area of the actuating piston was larger than the area of the transverse section of the torpedo. This feature has been copied in constructing the projectile torpedo of the Destroyer, the piston which expels the same presenting an area of 314 square inches, while the sectional area of the projectile is only 196 square inches. Consequently, as the tension of the acting medium employed in the Destroyer exceeds 200 lb. per square inch, the torpedo will be pushed out by a force of $\frac{314 \times 200}{196} = 320$ lb. per square inch. The distance passed by the piston while impelling the torpedo being 30ft., an energy of nearly 2,000,000 foot-pounds will thus be imparted to it.

The torpedo of the Destroyer, like the device of 1854, is composed of a solid block of light wood, the explosive charge being contained in a metallic vessel inserted at the forward end. The form, however, is different. Instead of being circular, as in the plan presented to the French Emperor, the transverse section of the wooden torpedo of the Destroyer is square, with parallel top and bottom and vertical sides, forming very sharp wedges at both ends, cased with steel plates, its extreme length being 23ft. The detail of the instrument is particularly described in the patent granted for the invention by the British Government.

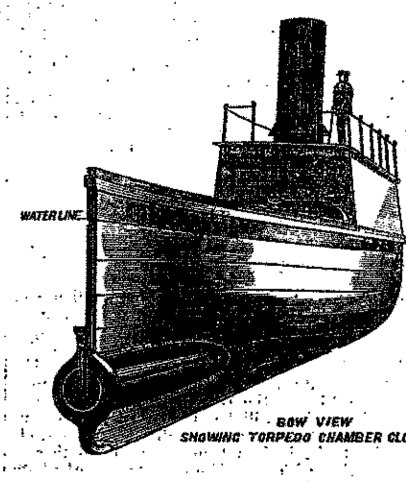
The foregoing will probably be deemed a satisfactory reply to the questions propounded in certain naval circles, concerning the projectile torpedo connected with

THE DESTROYER—TORPEDO BOAT.

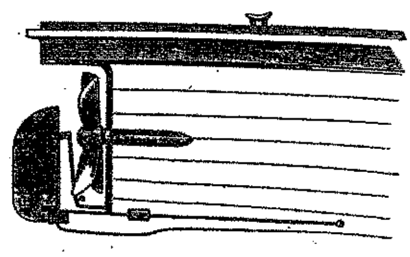




TORPEDO CHAMBER OPEN.



BOW VIEW SHOWING TORPEDO CHAMBER CLOSED



METHOD OF PROTECTING STEERING GEAR

the new system of submarine attack inaugurated by the torpedo vessel described in THE ENGINEER, 30th August, 1878.

Regarding the construction of the hull of the Destroyer, the assumption that the published description is incomplete, will be found groundless on carefully studying the explanation given, viz., that the upper and lower parts of the hull are divided by an intermediate watertight, strongly ribbed plate-iron deck running from end to end of the structure; the lower division—ventilated by powerful blowers—containing the machinery and affording a safe retreat for the crew during attack, while the upper division is filled with blocks of cork, excepting a small part near the bow occupied by wood-backing, and an inclined transverse armour-plate resting on the intermediate deck.

With reference to certain ingenious arguments intended to prove that the Destroyer, in consequence of its extremely fine lines, will turn very slowly, and thus be dangerously exposed should the attack fail, it will suffice to state that the discharge of the torpedo and reversing the action of the propeller will be simultaneous. Hence a retreat of the vessel in the opposite direction to that of the advance will commence before the submarine missile has reached the ship attacked. Obviously the recoil attending the discharge of a body weighing 1400 lb., impelled by the great force before mentioned, and moving through a distance of 30ft. before entering the water, will greatly assist in imparting a retrograde motion to the vessel. Finally, it should be observed that, owing to its peculiar construction, the speed of the Destroyer will be very nearly as great during backing as when going ahead.

New York, October 25th, 1878.

THE TORPEDO VESSEL, DESTROYER.

WE illustrate above the torpedo vessel referred to by Captain Ericsson. We have already described the boat pretty fully. It will suffice to say now that the Destroyer is 130ft. long, 11ft. deep, 12ft. beam, extreme; with both ends precisely alike, and terminating with very fine wedges, probably sharper than any vessel yet built. The peculiarities of the steering gear are shown in the cut. The top of the rudder is 4ft. under water. It is intended that the vessel during attack should be submerged as deeply as the monitors. As the plate iron deck house or cabin, 70ft. long, is rivetted water-tight to the hull, and has no opening in the sides, the vessel can be run with her upper deck below water.

CHICHESTER WATERWORKS.

THE prominent position now taken among engineering questions by those of water supply, especially to small places, will make the following illustrated description of Chichester Waterworks of considerable interest to our readers. The conditions of site are somewhat unusual, but the works contain several features of engineering interest, and are such as are suitable for a large number of towns. The city of Chichester is indebted for this supply to the Rev. Professor Swainson, who was the prime mover in the formation of the company, which in 1873 obtained an Act of Parliament, authorising the construction of the works. These have since been satisfactorily completed, and now provide an ample supply of excellent water. The source of supply is a well sunk in the chalk, adjacent to a powerful spring one and a-quarter miles west of the city. The exact position of the well was determined by the certainty of an adequate supply being obtainable near the spring, while its location so far from Chichester was fixed with a view to avoid the contaminated water enclosed in the geological basin over which the city stands. This basin consists of a thin bed of gravel, contained in the clay of the "Reading Beds," and previously served for each house the usual double purpose of a receptacle of sewage and a source of water supply.

The company's well is sunk clear of this basin on the southern edge of the area of clay which extends from near Worthing to Portsmouth, and which is 1⅛ miles wide at the point in question. From the north edge of the clay to the summit of the South Downs is chalk, generally with flints, for a width of seven miles, which serves as a gathering ground and natural storage reservoir. The water in the chalk, being kept down by the clay, rises again on its southern edge in powerful springs, so that the well had only to be sunk through the clay to secure a copious supply. This was effected at 47ft. from the surface. The chalk was reached at 26ft., and after it had been penetrated 21ft., the water could no longer be kept down by two 12in. pumps, and the sinking was stopped. It then rose to the surface, and overflowed, and has since continued to do so, except when the pumps are at work. An analysis showed that the quality was of the character usually found in chalk waters of the first class, and the hardness was 15 deg. on Clarke's scale before boiling, and 4 deg. after boiling.

The works consist of a pumping station—partly illustrated in our last impression—at the source of supply, a main pipe, 2¼ miles long, passing through the city to a service reservoir and tower, and four miles of distribution pipes. They were designed to supply eventually a population of 10,000 persons with 20 gallons per head per day. At the pumping station the sinking of the well was commenced with wooden cylinders 6ft. diameter inside the kerbs, for a depth of 17ft., after which it was continued with wrought iron cylinders 5ft. 8in. inside diameter. The cylinders were 9ft. long, connected by angle-irons 3in. by 3in. The plates were $\frac{7}{16}$in. thick, and the rivets were countersunk on the outer side. The wooden cylinders were lined with brickwork in cement, and the junction between the brickwork and iron was securely caulked with oak wedges. A foundation for the superstructure of the engine-house and the engines was secured by a dome of cement concrete, as seen on page 318 of our last impression.

The engines—see page 336—and pumps are in duplicate, but by different makers. They were each designed to raise on trial 10,000 gallons per hour against a head of 200ft. with a consumption of 3½ lb. of Welsh coal per horse-power estimated by the water lifted, and in actual work they each lift 11,500 gallons per hour against a head of 160ft. with a consumption of 4 lb. per horse-power, water lifted. The first of these engines and pumps were made by Messrs. Hathorn, Davis, and Davey, of Leeds. The engine is horizontal, and of the usual compound type, with the high-pressure cylinder towards the crank and in front of the low-pressure cylinder. The diameter of the high-pressure cylinder is 9¾in., and that of the low-pressure is 18in., and the stroke is 2ft. The exhaust steam passes into a common injection condenser, supplied with cold water from an adjoining pond or from the air vessel on the main. The crank shaft is carried between two bearings, both fixed to a cast iron bed plate. On the end of the crank shaft is placed a disc, from which the pump is driven direct from the main shaft. The pump is of the plunger and bucket type, the diameter of the plunger is 8in., that of the bucket 11in., and the stroke 1ft. 6in. Steam is supplied from two Cornish boilers of 4ft. diameter and 14ft. in length, with one flue in each of 2ft. 2½in. diameter. The speed of the engines was designed to be thirty strokes per minute, and in actual work they run from twenty-eight to thirty-five strokes per minute.

The second engine and pump were made by Messrs. Appleby Brothers, of London, who also supplied the duplicate Cornish boilers. The duplicates were provided before they were actually required by the demand for water, in accordance with the principle on which the works were designed, viz., to rely rather on machinery than on storage.

The main pipe, which is 8in. in diameter, rises 40ft. in its course due east along the public road to Chichester Cross, where it turns sharp to the north, and rises a further 60ft. to the service reservoir. This main is used for purposes of economy as a service main and distribution pipe, in its passage through the city, a circumstance which is attended with the disadvantage that it occasions great variations in the pressure causing such small engines to run away when there is a sudden draught of water at a street hydrant. To obviate this a weighted valve is fixed on the main at the engine house, which on any diminution of pressure at once throttles the flow of water. It is, however, proposed to check the engines more promptly by employing a slide valve on the steam pipe which is to be kept open by the pressure of the column of water, and to be instantly closed by a spring when the pressure is relaxed. This valve is being constructed, and may be the subject of a future notice if it answers the expectations formed of it, for there are often cases occurring where such a contrivance will save the cost of an independent rising main to the service reservoir, which is a matter of great importance where the distance is considerable. There are other advantages derivable from the use of the rising main as a service main, for in the first place the size of the service main can be thereby reduced by the amount due to the circumstance that during the period of maximum demand the flow of water is towards the demand from both ends, the pumping station and the reservoir; and besides, where, as in the case of Chichester, the available head of water due to the reservoir is low, a greater head than the reservoir can give can be maintained during the working of the pumps which usually coincides with the period of maximum demand. With such an arrangement also the size of the reservoir can be reduced to what is sufficient for the surplus supply during pumping hours, and for the storage capacity required to maintain the flow during the hours of rest which, being chiefly at night and on Sundays, correspond with the minimum demand. For these reasons the main pipe at Chichester was made 8in. in diameter, and the reservoir was designed to hold 100,000 gallons only,