a dial showing the level of the water in the sewage wells. Thus, if during wet weather the attendant at the controlling station finds that the combined flow is more than the pumps can cope with, he would shut down the valve controlling the sewer from Lackey-street,and if he still saw that the flow from the Devonshire-street sewer was greater than the pumps could cope with, he would shut off this section also and leave the third section only to be dealt with.

It is considered that the pumps will be able to cope with this flow at all times.

The penstocks are controlled from a small valve placed in the controlling room.

No. 2 station also intercepts the large existing sewers which flow at the present time into the Blockwattle Bay. One of these, known as the Wattle-street sewer, commences about 15 chains on the upper side of George-street West. This sewer is 6 feet by 4 feet, and carries a very large volume of sewage.

Where it crosses George-street it is just above a large inverted syphon, forming a portion of the main sewer flowing along George-street West, and joining the Main Northern Sewer, which discharges at Ben Buckler.

This syphon was a necessity to cross the very low dip in George-street West, below the Newtown Junction. One objection to a syphon in sewage work is that it must always remain full whether the flow is large or small, and, therefore, during the periods of minimum flow settlement must take place. It, therefore, becomes necessary to introduel a scour valve. This valve is periodically opened and the syphon flushed out. The scour from the George-street syphon ot present flows into a storm-water channel, and is discharged into the waters of Blackwattle Bay. But means are now being provided so that this sewage can be intercepted at No. 2 pumping station.

He had mentioned that the Wattle-street sewer just crosses over the top of the syphon; in fact, the invert of the Wattle-street sewer encroaches on the crown of the syphon, but as this portion of the Wattle-street sewer is laid on a steep grade, a little way down Wattle-street, the invert of the sewer is below the invert of the syphon.

Advantage is taken of this fact, and the scour from the syphon will be led into the sewer. At the lower end of the Wattle-street sewer, where it goes through the Wentworth Park, a valve house will be constructed.

In this will be placed a gate valve actuated by a hydraulic cylinder. The position of this gate was fixed so that when the contents of the syphon is discharged into the Wattle-street sewer it will not quite fill the sewer up to the top at the valve house.

The flushing of the syphon will be expected to be carried out during the night time, when the pumps at No. 2 station will have little to do, and the flow in the Wattle-street sewer will be correspondingly small.

The gate in the Wentworth Park will be closed, the syphon scour opened, and the sewage will flow into the Wattle-street sewer and from thence to the pumps. But as the capacity of the pumps is not sufficient to cope with the discharge from the scour direct, the Wattle-street sewer is made to form an intercepting reservoir from which the pumps can draw.

Should it ever happen that a storm occurred during the time that the syphon is being flushed, and the water started to back up in the Wattle-street sewer higher than the calculated line, an automatic releasing feature on the gate will be brought into operation and the contents of the sewer released.

As the pumping station on the Marrickville flats has just been completed, perhaps a short description of this plant will be found interesting.

The installation at present consists of two Hathom Davey and Co.'s differential pumping engines and two Cornish boilers fitted with Greene's feed water economiser.

The engines are capable of raising 45 gallons per sec. a lift of 40 feet, including friction, through 2355 feet of 22½in., rising main, the guaranteed efficiency being that each engne shall not consume more than 30lbs. of steam per hour when running at normal speed.

The steam consumption to be measured by the discharge from the pump, plus the drains from the cylinder jackets.

The pump horse-power being calculated from the exact displacement of the buckets, multiplied by the head in feet without deducting anything for slip.

The duty of engine economiser and boiler shall not be less than 60 millions per cwb. of New South Wales coal having the following analysis:—

ANALYSIS OF NEW SOUTH WALES COAL.

Water....................	0.86
Volatile Hydro-Carbons......	18.22
Fixed Carbon	69.84
Ash	10.80
Sulphur	.028

The engines are duplicates of each other, and are horizontal compound surface condensing dijerential type.

The cylinders being 15in. and 30in. diameter, by 3 feet stroke. Both the high and low pressure are steam jacket, with live steam, as are also the cylinder covers.

The pumps are of the vertical single-acting closed top bucket type, the barrels being of cast-iron, 30in. diameter, and having a 3ft. stroke. The buckets are of cast-iron, fitted with gutta-percha rings on the water packed principle.

The valves are of the back-flap type faced with leather, and backed with wrought iron, and having steel guards, suitable covers being provided for giving easy access to the same.

The Cornish boilers are 5 feet in diameter x 20ft long; the flues are 30in. at the front, and 26in. at the back, and have three circulating tubes welded in.

The economiser consists of 36 tubes 49.16 in external diameter, and is fitted with scraping engine, etc.

The boilers are fitted with a low water and high pressure safety valve and dead weight safety valve, besides the ordinary mountings. Mechanical screening apparatus is provided to free the sewage from the grosser solid before entering the pumps.

The foundations for the engines are taken down to solid rock, and the foundation for the duplication of the present plant was bluilt at the same time.

The duty trials on this plant have just been successfully completed, the machinery running very smoothly.

The boilers give ample steam; in fact, during the trial the damper doors had to be kept nearly closed.

Appended in tabulated form will be found the results of the trials, together with the indicator diagrams

A third boiler is now being erected to provide steam for a centrifugal pumping plant. This plant is intended to cope with any excess of stormwater brought down by the sewers, and will be capable of discharging 10,000 gallons per minute through a 33in. rising main.

The plant is situated in a very handsome brick building with sandstone facings, the engine-room being 72ft. 6in. by 35ft. 6in., and the boiler-house 54ft. 9in. by 40ft.

This concludes a description of the low-level sewage that has already been dealt with by the Department, the work of construction being either underway or completed. But there are some very large areas in the western suburbs which cannot be brought by gravitation into the main western sewer.

These areas, though they stand comparatively high, not being elevated enough to drain into the head of the sewer.

There are two methods by which these localities could be dealt with, viz.:—Either by pumping or by draining them to some point on the banks of the Parramatta River, and there treating the sewage before it is discharged into the river.

Until lately it would not have been advisable to consider the possibility of treating this sewage locally. As with the older methods such as is at present in force at the North Shore Outfall Works, the cost of the labour and chemicals required would have been too great, but with the advance of the science of the treatment of sewage, new methods are being discovered which have not these objections.

He proposed to give a short description of one such method that would in many cases do away with the necessity of pumping. This system is known as the Septic System.

SEPTIC SYSTEM.

In this system no chemicals are employed, and there is no "treatment" of the sewage in the ordinary sense of the term, its purification being accomplished by natural agencies, the purpose of the Septic tank being to foster the multiplication of micro-organisms, and bring the sewage under their influence. The capacty of the tanks must be equal to about 24 hours' dry weather flow.

And as the germs that it is desirous to cultivate are anaerobic, it is necessary that the air and light should be excluded.

Until lately it was deemed necessary, therefore, to cover the tanks over and trap both the inlet and outlet thereto, thus effectually obtaining the required results. But of late it has been found in England that even this is not absolutely necessary, as during the Septic action a thick scum forms on the surface of the liquid, consisting of floating matter undergoing decomposition. This scum forms a natural cover, to a very large extent excluding light and air.

Whether leaving off the covering would be as successful here as it has been in England he was not prepared to state.

During the warm weather the scum is very much thinner than in the cold weather, and, as the temperature is considerably higher here than in England, it is possible that the covering of scum would not be sufficient in the summer time. There will be always one objection to the cover being omitted, and that is the scum being so unsightly. The action in the Septic tank is exceedingly rapid, and during the time that the sewage remains in the tank very material changes take place, the more complex substances contained in the original sewage being converted into simple compounds, and these in their turn are reduced to still simpler forms, the ultimate products being of such a character that they are very readily treated in the subsequent operations. After leaving the Septic tanks the effluent is discharged on to a properly-prepared filter-bed.

These beds are composed of gravel, coke, coal, broken stone, or in fact almost any material that is sufficiently open to allow the air to be drawn into the pores of the filter.

On the other hand, if the material is too fine the filters are liable to become choked.

The filtration of sewage is not a mere straining action; if it were so, the filter must soon clog.

The work done in the filters consists in oxidation of the products from the tanks, these being converted into nitric acid, which at once combines with the bases present and forms nitrates.

This result is obtained through the medium of micro-organism, but these organisms differ absolutely from those contained in the Septic tank.

They are aerobic, and therefore require the presence of oxygen for their development. And the whole secret of success or otherwise of these filter-beds seem to be founded on some material that will readily absorb oxygen.

At Rookwood Asylum the Departmentha ve constructed a plant to deal with sewage of the 1000 inmates. This plant has been in operation about 12 months, and has been very successful.

There are two Septic tanks having a 30-hour capacity calculated on 50 gallons per head per day.

Each tank is 37 feet by 22 feet, constructed of concrete and covered with a light Monier roof.

The sewage enters and leaves the tanks under sunken weirs, thus the light and air are excluded.

From the Septic tank the sewage flows over an aerating cascade formed of concrete steps, into a collecting gutter.

From this gutter it passes by an iron trough to a cast-iron pipe running along the lower end of the filters adjoining the cascade. There are three filters side by side, each being 39 feet by 14 feet.

They are filled with coke breeze to a depth of 3ft. 3in., and have 8in. of gravel on top. The capacity of these filters is about 13,500 gallons, and, as the estimated sewage flow is 50,000 gallons, the filters would fill four times during the 24 hours. The cast-iron pipe running along the end of the filters has branches conducting the sewage to the centre of each bed, where rotary valves are fixed, and through these valves the filters are supplied.

The outlet from each tank is fitted with a similar valve, these valves being placed immediately below the inlet valves.

The three supply valves are keyed to one 1½in. shaft, and the three outlet valves to another, each supply valve being made to revolve with the corresponding outlet valve below it by means of a connecting rod and cranks on the two shafts. All the valves are thereby reciprocating.

They are worked automatically by the effluent itself, which, when it fills each filter, overflows into a bucket suspended from a quadrant arm keyed to the shaft of the supply valves. This bucket on being filled falls and turns the shaft, causing every valve to move through one-third of a revolution. The bucket on falling strikes against a pin in the bed plate below, which raises a valve and allows the bucket to empty so that it can again rise by the time the filter adjoining has become full, when its bucket will be filled, and the shafts with the valves attached will make anither one-third of a revolution. Therefore, the same action will occur as each filter becomes full.

It will thus be seen that from the time the sewage flows into the Septic tank until it is discharged purified from the filters the whole process is automatic.

These works have been in operation about 12 months, and during that time have not given the slightest trouble. The average numerous samples taken for analysis have shown a purification equal to 85 per cent., which may be considered very satisfactory.

APPENDIX.

MARRICKVILLE LOW LEVEL PUMPING STATION.

Report of Trials made of the Pumping Engines under normal working conditions on July 19th and 24th, 1900.

The object of these trials was to determine the steam consumption of the engines, the power generated in the steam cylinders and exerted by the pump plungers, the evaporated efficiency of the boilers, and the duty of the engines in terms of million foot pounds per hundredweight of coal consumed.

On each day of the trials the boiler was started with a clean fire; after the fire was well away and steam at working pressure the engine test was started; at the end of the test the fires were left practically the same as at the start. The quantities determined are:—The weight of coal; the weight and temperature of feed water supplied to the boiler; the speed of the engines; the weight of steam used by the engines, both in the cylinders and jackets; the steam pressure at the boiler and near throttle valve of the engines; the power of the steam cylinders and of the pump plungers.

The coal was weighed in a barrow and served to the boiler-room as required, one hundred-weight at a time. The feed water was supplied to a measured tank, from which the feed pumps were supplied; the tank was filled and emptied to the same marked height every time; at the end of the tests the amount remaining in the tank carefully measured and allowed for. The water level in the boiler at the beginnig of the test was marked and at the end of the test the water level was brought to the same mark.

The speed of the engines was determined by the engine counters, a full stroke in and out being for the purposes of this report called one revolution. During these trials the engines worked smoothly and well, maintaining practically the same speed during the whole time over which the trials extended on each day; readings of the counter, steam pressure, and vacuum gauges, and also temperature of the feed water, were taken every fifteen minutes.

The water discharged from the hotwell was caught in a tub, which was allowed always to fill to the same marked height, the tub being then emptied and placed in position to fill again before the next stroke of the pump. In this way, together with the condensed steam from the jackets, which was also measured in a similar marked tub, the weight of steam used by the engines was determined.

The power of the steam cylinders was determined by the aid of indicator diagrams taken every half-hour for the first six hours and every hour for the rest of the time; specimen diagrams being attached to this report, all of which have been reduced by the aid of planimeters.

The power of the pump plungers was determined from the total water column against which the pumps worked, including friction, the total capacity of each pump being taken and no allowance made for slip. The total head being determined from an average of readings taken every fifteen minutes, above or below datum on a graduated rod fixed in the pump well; this average reading being added to or deducted from the height of pressure gauge on the air vessel above datum of aforesaid graduated rod, plus the average reading taken every fifteen minutes of the pressure gauge on the air vessel.

The fire grate area was measured and found to be 12.5 square feet.

The trials on each day extended over a period of 12 hours.

On the first day "B" engine was run, and on the second day "A" engine was run, in each case under the same conditions and using the same boiler.

These distances require multiplying by 2 of the total length of main from the controlling station to the pumping station and back again to the controlling station is required.

RETURN MAINS.

The sizes of mains given in the table are estimated on the basis that the length of the main is twice as long as that given to allow for the return; but instead of actually taking cables of the full area back to the controlling station, it is proposed to reduce this, as follows:—

On the Balmain side, Stations Nos. 2 to 11. Returns of the same size as the positive mains will be taken from Stations Nos. 11, 10, 9, 8, and 7, as far back as the position of Station No. 7.

From Station 7 to the junction between the overhead and underground mains, the return will consist of two No. 37/14, in addition to which each station from Nos. 6 to 3 will have a return of the same size as the Positive main. The length of the two No. 37/14 will be about 1.58 miles each. The underground bare copper return will consist of two No. 61/12, and one No. 37/13, each about 1.3 miles long. Station No. 2 will have an overhead return of the same size as the positive main for the whole distance back to the controlling station.

On the Sydney side, stations Nos. 12, 13, 14 and 15 will be connected by means of short lengths of cable, each of the same size as the positive main, to a 19/12 overhead return along Kent--street from Argyle-street to Liverpool-street, about 1.22 miles long.

A separate overhead return of the same size as the positive main will be taken back from Station No. 16 to the intersection of Kent and Liverpool streets. Station No. 17 will have a return of the same size as the positive main as far back as the junction of Liverpool and Riley streets. The underground bare copper main will consist of two 37-12 from the intersection of Kent and Liverpool streets to the controlling station, about half a mile in length. Another bare copper return, No. 37/14, will be run from the intersection of Kent and Liverpool streets, up Liverpool-street to Riley-street for Staton No. 17; this will be about 2.45 miles long.

All sizes and lengths of mains given herein are approximate only, and were merely intended as a guide to contractors.