Introduction.

Melbourne, the capital city of the State of Victoria, has a present population of approximately 1,000,000, but provision is being made for 1,700,000 within 11 years, with a further increase of 2,222,688 within 35 years' further period (1975).

Even that figure by no means exhausts its possibilities. It is to be borne in mind that the present population of Victoria is 1,743,000, whereas the State is capable of supporting at least 20,000,000, and all the railway, road and irrigation works have such a future in view. Also it is beyond doubt that Melbourne will be not only the metropolis of this State, but of the greater area to the north of which it is geographically the terminal port.

The difficulty of carrying out works, that whilst capable of extension to meet the great future that is approaching and that still shall not overburden the present, the uncertainty in predicting what advance in methods the future may hold, is a labour of extreme difficulty. Already the Metropolitan Area covers 277,760 acres, or 434 square miles, and all that must be served even though, judged by the standard of other great cities, the population is, throughout the large districts, sparse.

How the problem has been approached, what has been done, what provision has been made for harmonious extension is the purpose of this address.

Historical.

The earlier phases of The Melbourne Sewarage System were in common with that of pioneer cities of uncertain future in new lands, primitive in the extreme; and so it remained for many years until an assured future justified works of a monumental nature.

Until that period arrived sewerage was conducted in open channels through the streets into the river. No attempt was made to differentiate between human liquid excrement, storm water and household foul water—all went the same way, and the pollution of the river, especially in periods of low flow in
droughts, became exceedingly serious. Up to that solid 
human excrement was pan and cess-pit collected, and re 
moved to garden and agricultural depots in tank carts.

Passing over a period of simple pioneer and tentative 
experiments, the beginning of the history of the present 
system was in the year 1889, when the Government decided 
to engage Mr. James Mansergh, of Westminster, England, to 
visit Melbourne as a consultant to report upon the sewerage 
of Melbourne and suburbs. The report, a most voluminous 
and exhaustive one, dated 1st August, 1890, was presented 
to the Government in 1890, and, with some modifications, is 
the basis of subsequent accomplishments. On 20th Decem-
ber, 1890, an Act to provide for the better Local Management 
of the Metropolis and for the creation of the Melbourne and 
Metropolitan Board of Works was passed. This authority 
was created to take over and consolidate and administer the 
whole of the then existing water supply and sewerage ser-
dices of the Metropolis, and to introduce throughout the whole 
area the water borne method. The Board consists of 39 
members, who are nominated by the various municipalities 
affected, and a chairman elected by the members.

The Board's first engineer-in-chief was the late Mr. Wm. 
Thwaites, M.A., M.C.E., M.Inst.C.E., who was in control of 
all the activities. His successor was Mr. C. E. Oliver, 
M.C.E., M.Inst.C.E., also in charge of both services. On his 
retirement the Sewerage and Water Supply Departments were 
separated and administered by separate chiefs, Mr. W. Wil-
son, M.Inst.C.E., in charge of the sewerage, and Mr. E. G. 
Ritchie, M.Inst.C.E., in charge of the water supply. and later, 
on the retirement of Mr Wilson, Mr. A. M. Grant, M.C.E., 
was appointed in his place as engineer of sewerage, Mr. 
Ritchie still retaining the position of engineer of water supply.

Statistics.

How great has been the growth of the metropolis will be 
gathered from the analysis of the subjoined extracts from 
official data.

The population for which sewers are provided has in-
creased from 17,358 on 30th June, 1898, to 921,453 on 30th 
June, 1927.

The mileage of sewerage reticulation has now reached a 
total of 1875 miles from the commencement in 1891-92 to 
30th June, 1927, at an expenditure—including the necessarv
mains and branches (191 miles in length)—of £8,171,990, the annual revenue collected being an average of £261,857, and for 1926-27 the revenue was £633,165, being for all services of the total cost is £10,493,351.

The grand total length of all sewers, etc., including rising mains and outfall sewer, being 2090 miles.

*Water Supply.*

Necessarily the increased water consumption involved, first by the natural increase of population, secondly by the increased volume required for water carriage, has led to a complete reorganisation and great extension of the water service also. Not only the causes named, but the greater use of water per individual for household purposes and for gardens has increased the difficulty of the problem and of adequately forecasting the future.

Another complication is the very great variation in annual rainfall and run off. As the whole of the present supply is derived from the River Yarra and its tributaries, reference to the graph attached will show the flow variation at Melbourne, and make this clear.

It will be at once seen that storage reservoirs become an essential to equalise conditions, and that although they are great now, they must be much greater in the near future than when the stopping of the running flow with moderate storage sufficed.

Necessarily this implies a heavier capital expenditure than would be the case were the conditions those of certain other great cities, where the available stream flows are relatively great in proportion to the requirements.

The principal storages existing and under construction are:

<table>
<thead>
<tr>
<th></th>
<th>Capacity in Gallons</th>
<th>Daily Quantity that could be delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yan Yean</td>
<td>6,400,000,000</td>
<td>33,000,000 gallons</td>
</tr>
<tr>
<td>Toorowrong</td>
<td>60,000,000</td>
<td>9,000,000</td>
</tr>
<tr>
<td>Maroondah</td>
<td>6,274,000,000</td>
<td>50,000,000</td>
</tr>
<tr>
<td>O'Shannassy</td>
<td>964,000,000</td>
<td>60,000,000</td>
</tr>
<tr>
<td></td>
<td>13,698,000,000</td>
<td>152,000,000 Total</td>
</tr>
</tbody>
</table>
The daily available supply when all these storages and services are in operation will therefore be 152,000,000 gallons.

The record call upon the water supply in any one day in hot weather up to date was 116,397,000 gallons on 11th January, 1928.

The catchment areas are wholly reserved from occupation. In all the more recently acquired areas the primeval forests, containing trees of very great height and magnitude, still stand, and it is the Board's policy also to resist the destruction of forests in areas that serve the tributary streams, but are not yet under its undivided authority. The natural balance established by these forests, the absence of erosion and many other less obvious operations, have led to a run-off of singular purity that could not be increased by any denudation or other alteration of the natural conditions at present predicable.

Of course, such purity is not essential for mere sewage conveyance, but there can be no differentiation between the potable and sewerage water supply services.

The forests and other reserves comprise 108,840 acres, and with the desired Upper Yarra Scheme a possible total of 198,840 acres.

The aqueduct systems have a mileage of 1533, the arterial pipe lines a length of 2853 miles, and the street reticulation a total length of 18743 miles. The grand total equals 2313 miles.

So much have the requirement increased, and so much has the rainfall from the nearer areas declined owing to the deforestation of those districts in early times and subsequently to bush fires that, notwithstanding all the provisions and palliatives mentioned, it may be necessary to go still further afield and to tap other streams in the not distant future.

The whole of the water is supplied by gravitation.

Mansergh's Basic Scheme.

Mr. Mansergh made the following assumptions:—

(1) That the rate of natural population increase would be 2½ per cent. per annum.

(2) That the population in 1939 would be 1,700,000.
That the population distribution would, at first, vary between 10 and 50, or an average of 22.2 per acre.

That the population at 1939 would be housed in about 400,000 tenements, 4.43 per tenement (which has been proved by census returns).

That the sewage to be pumped in 1939 would be 125,972,625 gallons per day, and that of this the portion derived from 66 per cent. of the area would, ultimately, trend eastwards, and that from the remaining 34 per cent. of the area westwards.

Mr. Mansergh evolved and tested no less than seven schemes, but fully elaborated in detail one only, namely, the "M" Scheme.

The soundness of these assumptions has been strongly corroborated by the results of actual experience of the 39 years which have since elapsed.

There have been deviations from the above final recommendation. For instance, a considerable part of the flow from the eastern area was to be raised by a pumping station at South Yarra, and was to flow eastward to Mordialloc beside Werribee. The whole of the present catchment area, however, discharges to the west.

Further deviations have been made in respect to the position of the sewers, principally that the line should be more direct, but also in regard to dimensions, Mr. Thwaites being of opinion that it would be safe to assume that the main sewers could run two-thirds, instead of one half full.

The scheme recommended for adoption by Mr. Thwaites is substantially the "C" Scheme evolved by Mr. Mansergh. With slight modifications this is the proposition now in operation.

Difficulties in Growing Cities.

Melbourne's population now numbers about 1,054,600. This would not be difficult to deal with under the conditions of the application of a new system to an old settled area. But this is not the condition in Melbourne. The population is spread over such a far-flung territory (its area is 277,760 acres, or 434 square miles, and its greatest straight line distance across 26 miles) that it has no parallel elsewhere; and in places the distribution is very sparse.
Necessarily this largely increases capital costs and unremunerative reticulation. The financial disability is so great that consideration of the segregation of the settled areas and the sewering of those areas by methods based upon the bacterial treatment of sewage is being forced upon consideration.

Although much data derived from experience elsewhere is available, it is felt that every care must be taken to insure that, if such methods are introduced, there can follow no failure. To this end experimental work is being done on a considerable scale at Kew, where this type of treatment is in limited use.

*Kew Treatment Plant.*

The experimental station at Kew was initially installed to reach an island settlement in difficult country, which would have cost £20,000 to connect with the gravitation reticulation. The system comprises separation of solids by sedimentation, fermentation of the solids, continuous oxidisation of the effluent in a percolating filter bed, and final treatment in a secondary sedimentation or "Humus Tank," the clarified fluid passing into the River Yarra.

The conditions postulated are that the discharge into the river must not contain more than three-parts of suspended solids per 100,000 of liquid, and that the liquid must not, at 65 deg. F., take up, in five days, more than one part of dissolved oxygen per 50,000 parts.

These local experiments are quite essential to secure that all the local conditions, some of which may be unsuspected, are fully represented in the results.

A Town Planning Commission of an advisory character has been constituted by the Government, and is functioning. One of its endeavours is to arrange that certain "zonal" areas shall be introduced to prevent too dense accumulation of street-living settlement. Such areas are to be devoted to agriculture, horticulture, and similar services. Obviously these areas would make their sewerage requirements very difficult of attainment were they reticulated in the ordinary manner. It may be necessary, as above mentioned, to segregate them as units served by methods operating wholly within their boundaries.

Manufactures also introduce difficulties increasing with time. Hitherto the manufacturing industries giving outflow of chemicalised trade liquid wastes have been relatively small, but there is every indication that the future holds great local
possibilities in this direction. To admit untreated such effluents into the sewers would very seriously retard or prevent the organic chemical processes tending to break in transit the sewage into innocuous compounds of manurial value. The Commission's proposal that such industries should be localised would, if practicable, decrease the difficulties of the problem, but it may not be practicable, and if not, there must be introduced some mode of treatment that may permit of the reception of such liquid when it cannot be discharged into watercourses.

As storm water conveyance forms no part of the sewerage system, due provision for this phase may be found a solution for the trade waste difficulty also.

The Methods of Disposal.

The whole sewage effluents at present fall by gravitation down to a low level at Spotswood, namely, 45.00 feet below low water mark. Thence the flow is raised by pumping to a level of 64.50 feet above L.W.M., and thence gravitates by pipe lines and aqueduct to the Sewerage Farm at Werribee, 20 miles away.

The pumps were originally of the balanced reciprocating type. The makers of the first No. 4 pumps were Messrs. Thompson and Co., of Castlemaine. Subsequently one pump was constructed by Messrs. Hathorn, Davey and Co., England, and five (5) were constructed by the Austral Otis Co., making 10 in all. These continued in high duty service until a policy of utilising electric power from the Railway Department Generating Station at Newport came into operation.

Additional requirements were then met by five (5) electrically driven centrifugal pumps, and the whole installation has now been unified on that basis. Seven of the steam-driven pumps are held as a standby.

The average volume pumped per 24 hours is 34,382,411 gallons. The total head from all causes is about 125 ft. The average horse power exerted is 1250 B.H.P. The cost being .447d. per 1000 gallons raised 100 ft.

Sewage Farm.

This, as stated, is at Werribee, 20 miles from Spotswood, 24 miles from the Melbourne Post Office and 35 miles from the most distant part of the reticulation.
The nature of the formation is that of a thin layer of sandy and moderately permeable soil, but under this is a band of hard, stiff, impervious clay, beneath which the ground is more porous.

The area is 22,634 acres.

The total cost of land at Farm, including law costs, etc., £473,179.

The liquid is distributed by gravitation to feed irrigated crops. These crops consist chiefly of English rye and prairie grass, maize and lucerne hay.

The revenue derived from the farm for the year 1926-27 was £35,097.

The net cost of sewage purification for the same year was £44,929 = 11.70d. per head of population served.

The average net cost of sewage purification per annum per person served for the past 20 years was 5.91d.

Average quantity of sewage delivered daily on the Farm for the year 1926-27 = 34,382,411 gallons, equal to 126.65 acre feet per day.

Duplication of Outlet.

As stated in the description of the Mansergh's Scheme, provision is therein contained for the ultimate division of the gravitational plan westerly to Werribee and easterly and southerly towards Mordialloc, the sewerage parting roughly between Flemington Road, Victoria Street, Hoddle Street and line midway between Dandenong Road and Brighton Road.

It was expedient and good economy to, at first, limit the flow in the westerly trend, but with changing conditions it will not be long before economy will dictate the giving effect to the provision of relieving the western system by providing its eastern complement.

Public Health.

Naturally the removal of the old bad and insanitary system, and the substitution of the water borne sewage removal, has had a reflex in improved public health conditions. Whilst it has not been the only cause operating, it has been a principal one, and reduction almost to elimination of some of the filth diseases has been marked.
According to the report of the Medical Officer of Health, Melbourne (Dr. Jamieson), for 1887 (quoted in Mr. Mansergh's Report), the death rate for the whole of Melbourne and suburbs was 21.29 per 1000. The death rate for last year, 1927, was 10.15 per 1000 only. Thus the reduction amounts to 11.14 per 1000 per annum. As the population of Melbourne is now approximately 1,000,000, it follows that the annual saving of life due to better conditions, of which the sewerage is the principal factor, now amounts to 11,040 per annum. The money value of, not only the life saved but of sickness avoided, is therefore very great indeed.

Taking the death rate in 1898, when houses were being connected to the sewerage system, as 18.60, and the present rate at 10.14, the saving of life on this basis is equal to 7910 for this year.

*System Developed in Other Victorian Cities.*

There is a very great discrepancy between the population of the capital and that of any other city in the State.

Those next in sequence have populations of—Geelong 42,300, Ballarat 41,910, and Bendigo 33,910 only.

There are many smaller but progressive cities and towns, and in all of them is a trend to abandon with the greatest speed financial conditions allow the insanitary methods of the past.

Many of these places have their own peculiar disabilities, either in the limitations of water supply or in the non-availability of rivers into which an effluent, after treatment, can be discharged without danger to the local and down-stream settlements. But where these limitations are not prohibitive provincial centres are profiting by Melbourne experience and data which has been an object lesson to the State as a whole.

That experience was availed of also when the ex-Engineer-in-Chief, Mr. Oliver, was selected by the Commonwealth Government to prepare a scheme for the sewerage of the Federal City of Canberra, a work in which the writer had the honour of assisting him.

*Conclusion.*

My thanks are due to the Chairman of the Board of Works. Mr. David Bell, J.P., Mr. A. M. Grant, and Mr. McNichol.
Publicity Officer, for permission to peruse and use the authoritative data of the Board. Those who desire more detailed particulars may with advantage refer to:

Report on Sewerage and Sewage Disposal of the Melbourne and Metropolitan District, by James Mar sergh, 1890.

Water Supply and Sewerage Systems of the Melbourne and Metropolitan Board of Works, 1925.


It has unfortunately been found impossible to reproduce, as illustrations, the slides which have been exhibited on the screen.

To obviate mere repetition, the writer has avoided lengthy quotations from the above sources, and any attempt to frame other than a simple, easily-followed guide to the operations of a great public body.

The work of the Board is monumental; it is not for a day only, but for the centuries. It is intended to stand and function as the great aqueduct and sewers of ancient Rome function to-day, and as they functioned before the dawn of the Christian era. The work achieved in Melbourne and in the water catchments are greater than any Imperial Rome ever accomplished. They are as massive and everlasting; their life should be as great; their cost has been relatively low, and no waste has ever crept into the work. Of such results no great city need be ashamed.
Library Digitised Collections

Author/s: 
Smith, A. Casson

Title: 
Sewering Melbourne metropolitan area (Retiring President's Address)

Date: 
1928

Persistent Link: 
http://hdl.handle.net/11343/24690

File Description: 
Sewering Melbourne metropolitan area (Retiring President's Address)