REMARKS UPON THE DISPOSAL OF THE SEWAGE OF HOBART.

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A great deal of the discussion that has taken place upon the subject of the suggested methods of disposing of the sewage of the Metropolitan Drainage Area has been based upon ignorance of what has been proposed, and of the conditions under which the proposals have been made.

I have suggested three methods for the disposal of the sewage:—First, its purification by filtration through land at an irrigation farm; second, its purification by precipitation; and third, its discharge, after being screened, into the tideway of the Derwent. The irrigation system would cost about £125,000 for works, and would entail a yearly charge of about £12,000, which would necessitate a yearly rate of 10d. in the £1. The precipitation scheme would cost about £86,000, with a yearly charge of £10,500, and a rate of 8½d. in the £1. The direct discharge would cost £70,500, with a yearly charge of £7,500, or a rate of 6d. in the £1. Up to a certain point there are works needed in common by all the systems—the sewers must be built for collecting the sewage, and there must be some outfall work, and some pumping power provided. When this common work is done, the direct discharge may be carried out without any additional work. But if the precipitation scheme be adopted, it would be necessary to add to the work already done some large tanks, and some more pumping power. Or if the irrigation scheme be adopted, it would be necessary to add yet more pumping power, and to provide and prepare land, and to lay down pumping mains. Consequently no money would be wasted by completing the direct discharge system first; that is to say, either of the other systems could then be adopted by expending the difference between £70,500 and £86,000 in the one case, and between £70,500 and £125,000 in the other. I have, therefore, suggested that this direct discharge be tried first, as either of the others could be adopted without loss should it be found necessary. The following remarks are, therefore, to be taken—not as maintaining that direct discharge is in the abstract the best way to dispose of the sewage—but as showing that here the experiment of such discharge may be safely made; and that it would be unwise to proceed to further expenditure upon works until that experiment has been made, and seen to be unsuccessful.

With respect to what it is proposed to do, if the suggested plan for discharging the sewage without treatment into the estuary of the Derwent be adopted, the following are the facts:—There would be discharged into the tideway off Macquarie Point a quantity of sewage, estimated to amount in dry weather to 890,000gals. a day, about 4,000 tons. This means, if the sewage be similar in character to that of water-closet towns in England, that there will be there a daily discharge of less than three tons (6,418lb) of solid matters in solution, and of less than two tons (3,973lb.) of solid matters in suspension. Of the solid matters the noxious element may be said to be represented by 692lb. of nitrogen in solution, and 1,823lb. of organic matter in suspension. I have taken the Macquarie Point outfall as by far the principal one. Six times as much sewage will be discharged there as at Battery Point, and eight times as much as at the New Town outfall.

With respect to the conditions under which the discharge will be made; in the first place, as to the matter discharged, it will be seen that the greater part of it is in solution; as to the rest of it, it will be

screened so that all floating matter with a greater dimension than half an inch will be kept back and not discharged into the Derwent at all. In the second place, as to the recipient of this discharge, it is diluted sea water, the volume of which, in what may be considered the immediate basin of discharge, is about 60,000,000 tons; one fifteenth part of which, say four million tons, is, on an average, displaced and replaced every tide; and the dilution of which is caused by a mean daily inflow of about 16 million tons of land water. In the third place, as to the point of discharge, it is into the tideway—that is into a place where it will be directly affected and acted upon by the displacement and replacement caused by every tide, and by the inflow of land water, the joint forces of which will secure the commixture of the matter discharged with the recipient water, and also its downward flow towards the sea.

In connection with the second and third of the above-mentioned conditions, it should be mentioned that tidal action, though varying throughout a lunation, may be taken to be regular with regard to the lunations throughout a year. On the other hand, the inflow of land water varies greatly from the mean quantity stated. In April, 1884, in connection with work at Meadow Banks, the Hon. N. J. Brown told me that the Derwent was lower than either he or his manager had ever noticed it. I estimated that there was then passing 1,925,000 tons of water a day, say one-eighth of the mean daily flow. As this quantity is deduced from gaugings above the mouths of the Russell Falls, Styx, Plenty, Lachlan, Sorell, and Jordan Rivers, and numerous smaller streams, I think it safe to say that the minimum flow of land water past Hobart is not less than 2,000,000 tons a day. On the 23rd September in that year there was the greatest flood I ever saw in the Derwent, and in a paper I read before the Royal Society in that year, I find that I estimated from such calculations as were possible in the case, that 216,000,000 tons of water passed New Norfolk that day. As higher floods have been known, probably more than twelve times the mean daily quantity of land water sometimes passes Hobart in 24 hours. But whatever may be the fluctuations in the daily flow, it is certain that this daily flow must be of immense volume, as it represents the drainage of about 1,400,000 acres of "wet" area with a mean rainfall of more than 55in., and of more than a million acres of "dry" area with a mean rainfall of more than 20in. The consequent dilution of tidal water is clearly shown in the analysis given further on.

Taking into consideration the facts above given in connection with the conditions stated, the following deductions are evident:—1. That the noxious matter to be discharged is infinitesimally small in quantity when compared with the volume of water into which it falls. Taking the volume of the basin immediately in front of Hobart, the daily proportion would be less than one part in 28 million parts. Supposing the water of this basin to be drinking water, the addition of this quantity of polluting matter would take several months to reduce it, even if it were not being renewed, below the standard of purity for potable water as fixed by the Rivers Pollution Commissioners in England; consequently, as it is not drinking water, its addition cannot appreciably affect the Derwent.

2. That as none of the matter to be discharged will be floating matter of the character described as being cast ashore by winds or currents at Sandy Bay, the fact that such matter is there cast ashore has nothing to do with the question of what will become of the thin liquid sewage that will be discharged at Macquarie Point. If this does not affect the water of the basin into which it is to be immediately discharged, it certainly cannot affect the water of Sandy Bay still further off.

These are not merely theoretical deductions, but practical ones, of which the truth is capable of proof, and is being proved every day at Hobart. The Hobart Rivulet is, as everybody knows, in fact, and by

statute law, the common sewer of the city; and it must be borne in mind, in considering the following facts, that it discharges itself into Sullivan's Cove 600yds. further inland than the point of discharge into the tideway of the proposed new main sewer. On the mornings of the 4th, 5th, and 6th of January, during dry weather, I gauged the water passing under Campbell-street bridge, and the mean of the gaugings gave a daily flow of 2,240,000 gallons, or 10,000 tons. As these gaugings were taken above the inflow of the Park-street rivulet, they may be safely taken as showing a mean dry weather flow not exceeding the reality. Samples of the water were carefully taken at the same time. These samples certainly did not err in aggravating the impurity of the water, as, on the contrary, large floating impurities, such as a dead rat and filth that is better left nameless, could not be taken into the sample bottles. If they could have been, the samples would assuredly have shown a larger quantity of "organic matter in suspension." For the purpose of ascertaining the effect of the discharge of the Rivulet into the Cove, samples of the Cove water were taken at 13 yards from the mouth of the Rivulet, 100 yards from its mouth, and at a point 150 yards from the end of Elizabeth-street pier, and 450 yards from the mouth of the Rivulet. A sample was also taken in mid-stream of the Derwent, being half-way between Macquarie and Kangaroo Points. The following figures, all reduced to grains in the gallon of water, are the results of the Government Analyst's examination of these samples. I am greatly indebted to him for all the trouble he took in the matter. For purposes of comparison there are added the means of a large number of analyses of samples of sewage collected for the Royal Commission on Rivers' Pollution from more than thirty towns supplied with water closets; and of ordinary sea-water—the particular sample analysed—taken in the English Channel, but, as is well known, the composition of sea-water varies but little all over the world :—

CONSTITUENTS.	Hobart Rivulet, mean of three samples.	Cove-water 13 yards from mouth of Rivulet.	Cove-water 100 yards from mouth of Rivulet.	Cove-water 150 yards from end of Elizabeth-st. pier.	Derwent water in mid-channel.	Ordinary sea-water.	Mean of samples of sewage from water-closet towns.
Total nitrogen in solution..	0·61	0·20	0·06	0·02	0·015	—	5·41
Chlorine in chlorides ,,	18·90	581·00	1029·00	1127·00	1127·00	1365·00	7·46
Total solids in solution ...	62·33	1359·00	1948·00	2144·00	2151·00	2468·00	50·54
Organic matter in suspension	8·10	1·00	0·40	0·50	0·60	—	14·36
Mineral matter in suspension	11·33	1·80	0·90	0·90	1·10	—	16·93

These figures, taken in connection with the relative volumes of the dry weather discharges from the Hobart Rivulet and the proposed Macquarie Point outfall, give the following results, the first column showing the daily quantity discharged from the Hobart Rivulet into the Cove, and the second column that proposed to be discharged from Macquarie Point into the tideway :—

Of nitrogen in all forms in solution	195lb.	692lb.
Of chlorine in chlorides	6,048lb.	947lb.
Of all matters in solution..	19,945lb.	6,418lb.
Of organic matter in suspension..	2,592lb.	1,823lb.
Of mineral matter in suspension..	3,625lb.	2,150lb.
Of all solid matters in solution and suspension..	26,162lb.	10,391lb.

It will be noticed that the only matter that is greater in quantity at the Macquarie Point outlet than at the Hobart Rivulet is the nitrogen in solution. If the discharge were into a small basin of drinking water,

this matter would be of importance; but as it is into a large basin of salt water, it is of none, for it is in solution, and cannot pollute the shores of Sandy Bay, nor any other shore. But all other matters are in excess at the Rivulet—the total quantity of solid matter discharged there being two and a-half times as much as that proposed to be discharged at the Point. And it must always be borne in mind that the larger quantity is discharged into comparatively stagnant land-locked water, while the much smaller quantity is proposed to be discharged into running water, that is, the larger quantity is discharged where its polluting effect is certain to be the most marked and constant, and the smaller quantity where its polluting effect is equally certain to be the least, as the purifying effect of the recipient water will be the greatest. The purifying effect of water is due to the action of the oxygen it contains. Mr. William Odling, the celebrated chemist, in his evidence given last November before the Royal Commission on the water supply of London, said—"Four tons weight of oxygen is contained in every hundred million gallons of water (1 ton in 112,000 tons); oxygen had power to destroy 4-5ths of its weight of organic matter. This oxydisation is not a mere theory, but is based on solid fact." Of course, in order that this oxydisation may be effected it is necessary that the organic matter should be exposed to the action of the oxygen in the water- should, in fact, be brought into contact with it. This can only be secured by continual movement of the water, hence the well-known purifying effects of running streams.

Bearing all this in mind, it will be useful to note what is the effect of the daily discharge of the 26,000lb. of solid matter from the Hobart Rivulet into Sullivan's Cove. This effect can be noted in the analysis above given only in the constituents that are absent from sea-water, that is, the nitrogen in solution and the matters in suspension, as the immense quantity of salt and other solids in solution in sea water altogether mask the effect of the comparatively feeble additional quantity brought in by the Rivulet. It will be seen that to all practical intent the water of the Cove is as little polluted at 100yds. from the mouth of the Rivulet as it is in mid-stream, where the Rivulet cannot affect it. It is true that there are 4-100th parts of a grain more nitrogen to the gallon of water, but there 20-100th parts of a grain less organic matter in suspension. At 450yds. from the mouth of the Rivulet all trace of the effect of its discharge may be said to be lost, as the slight difference in the quantities of their constituents, when the water of the Cove there and that of mid-stream are compared, is attributable rather to the Kelly steps and Timber Wharf sewers than to the Hobart Rivulet.

The question to be answered is thus shown to be:—"If the discharge of 26,000lb. a day of solid matter into the comparatively still water of Sullivan's Cove has virtually no appreciable effect upon it, what will be the effect upon it of the discharge of 10,400lb a day into the tideway, 600 yards further away?" And we are asked to answer it, though we have proved the contrary, "that the effect will be disastrous." Can the force of unreason go further? Perhaps it can; and in the nature of the proofs that are given of what will be the consequence of discharging sewage at Macquarie Point. To say nothing of Sydney sewage being traced across 1,000 miles of Pacific rollers to the coast of New Zealand, it is said that the fact that the Hobart Rivulet, when in flood on the 18th of January this year, discoloured the waters of the Cove, showed what the effect would be of the proposed discharge of sewage at Macquarie Point. Now I gauged the water of the rivulet on that day, and found that very nearly 1,600,000 tons of water were flowing under Campbell-street bridge in the day—about 160 times the dry weather flow, and 400 times the estimated discharge from Macquarie Point. At the lowest estimate I could make without analysis, this water contained three times its usual quantity of earthy matter; that is, about

1,700,000lb, of mineral matter in suspension were sent into the Cove instead of the usual 6,000lb. of solid, and as compared with the 4,000lb. a day of the Macquarie Point discharge. Yet we are gravely told that the discharge of these 4,000lb. a day into the tideway outside the Cove would have the same effect as the discharge of 1,700,000lb. into the still water within it.

One other point is elucidated by the analyses. The quantity of salt in the mid-stream sample of the water as compared with that in sea-water, shows that the Derwent water was at the time and place ordinary sea-water diluted with 21 per cent. of river water—a fact that agrees with the estimates of the great daily downward flow of the fresh water.

DISCUSSION.

Mr. RULE said Mr. Mault had given nothing to show that the smaller quantity of nitrogen found at a distance from the rivulet was due altogether to the greater mass of water; it might be due to evaporation. He emphasised Major-General Tottenham's argument that the decrease of organic matter might be due to sediment, and agreed with him as to the tidal courses.

Dr. BRIGHT said that what was thrown ashore at Sandy Bay and other points might come from ships in harbour. People quite overlooked the fact that this drainage scheme was to improve the condition of the city from a health point of view. As a matter of fact, the health of the city was getting worse in preventible diseases. From 30 years' experience on the hospital medical staff, he could testify that the actual result of the atrocious pan system, misnamed the sanitary system of Hobart, was to increase the number of typhoid cases. Typhoid could be contracted by smelling as well as drinking. He agreed with every word of Mr. Mault's paper.

Mr. R. S. MILLES, City Surveyor, thought the discharge into the tide-way would not affect the health of the city. The chief cause of the present trouble along the shore came from the lighter matter always found in streets of cities, and brought down by flood waters. A separate system entirely would be impracticable at present, because, to his mind, there would be always a certain amount of expense entailed by repairs and maintenance of the present system of drainage; in addition to a cost of from £10 to £15 a house for connecting with the new system.

Dr. CROUCH approved of Mr. Mault's paper. The question was one of expense. If Mr. Mault had his choice of the three schemes submitted to the Metropolitan Drainage Board, that adopted at Southampton, the city more nearly approaching Hobart, would cause no ill effects to the Derwent.

Mr. F. M. YOUNG thought a mudbank might result at the outflow and be a nuisance to boats, but with that single exception there was nothing to be afraid of in the proposed system.

Alderman G. S. SEABROOK asked whether the scheme was to be a deep drainage system or otherwise, and for information as to the outlet to midstream. It would be manifestly unfair to ask the citizens to alter their present drainage and to repeat the operation a little later. His experience made him afraid that unless the drainage were carried right out into mid-stream it would find its way on shore. The suggestion for a destructor was worth consideration, and if the slaughter-houses were not removed he hoped one would be obtained and all refuse destroyed. Anything to remedy the present evils would receive his support either in the Council or elsewhere.

Mr. MAULT, in reply, said he proposed to burn the screenings, but that question was very much smaller than supposed. The daily volume of screenings of the sewage from 3,000,000 of people he had stood by and seen to be small enough to place on the table before him. And he hoped they would be burned in a destructor, which he did not think would be a costly affair. If anything were making the Corporation hold its hand it was the possibility of an arrangement being come to for a joint use of a destructor by the Metropolitan Drainage Board and the Corporation. Undoubtedly, whatever insoluble matter was brought down into the river must sink to the bottom sooner or later. But he had shown that if the volume of insoluble matter discharged were three times what it would be it would take 100 years to form a deposit 1in. thick over the bottom of Sullivan's Cove. It would cost £100,000 to take a sewer into mid-stream. The sewage would be discharged into deep water, and there would be no danger of a mud bank forming. There would be no difficulty, as anticipated by Mr. Milles, in the definition of public and private sewers. Nor did he anticipate, unless circumstances were very different to what they were in towns of a similar size in England, that the cost of connection would be anything like £10 a house. He thanked the meeting for the patient hearing accorded him.

Sir LAMBERT DOBSON, in moving a vote of thanks to Mr. Mault, said one little matter should not be overlooked. When the pan system was started no provision was made for emptying the pans. Before a drainage system was adopted there must be a water supply, otherwise the difficulty would be repeated. Therefore the public would be in the hands of the Corporation, and could not have proper drainage till a better water supply was provided. He quoted the opinion of a gentleman holding a high sanitary degree in England to the effect that the greatest danger to health was from the slops from houses.

The vote of thanks was unanimously passed to Mr. Mault, who acknowledged it.