

GOVERNMENT NOTIFICATION.—No. 60.

The following Report on Water Supply, Kowloon, by LAWRENCE GIBBS, A.M.I.C.E., which was laid before the Legislative Council this day, is published.

By Command,

J. H. STEWART LOCKHART,
Colonial Secretary.

Colonial Secretary's Office, Hongkong, 31st January, 1901.

SIR,—I have the honour to submit the following report on the subject of providing an adequate water supply for the Kowloon Peninsula.

EXISTING WORKS.

The existing waterworks were carried out on the recommendation of Mr. COOPER (*vide* his report on Kowloon Water Supply dated 30th June, 1892), with some additions suggested by Mr. CHADWICK. The following is a brief description of them :—

Three valleys at the back of the Rifle Ranges, having a joint area of 220 acres, are reserved as a collecting area, the water in the flat sandy bottoms of these valleys being intercepted by collecting pipes and led to shallow wells, below which dams are built across the valleys to prevent the escape of water underground. The wells are connected by iron pipes to a tank having a capacity of 150,000 gallons at Yau-Ma-Ti, whence the water is pumped into the distributing mains, the supply being regulated by two small service reservoirs, one near Yau-Ma-Ti 215 feet above sea level and of 160,000 gallons capacity, and the other near Hung Hom 160 feet above sea level and of 90,000 gallons capacity.

The minimum supply obtainable was estimated to be 232,000 gallons a day, and the population of the district to be supplied was, according to the census of 1891, 13,200.

The works were completed in 1895 at a cost of \$116,000, the regular supply being established on the 24th December, 1895. Small extensions of mains have since been undertaken at various times, and in the beginning of the present year the dam in the principal valley was raised 5 feet. Including these additions, the total expenditure under Mr. COOPER'S scheme has been \$128,000.

In 1898 the consumption was found to be rapidly overtaking the available sources of supply, and authority was obtained (C.S.O. 2²/₈1²) to construct works for the collection of an additional supply from the hills in the New Territory. These works are now in progress, but they can only be regarded as a temporary means of augmenting the supply until the more extensive scheme, about to be described, can be carried out. They will bring the minimum dry weather supply up to 300,000 gallons a day, which is sufficient to meet the present requirements of the district now supplied.

Before proceeding to enter into details with regard to the new scheme, it may be pointed out that, with an ample gravitation supply and sufficient storage, fire hydrants can be provided throughout the district, there being no provision whatever of this nature at present, and further a great saving would be effected in maintenance, the cost of pumping alone for a supply of 200,000 gallons a day being above \$5,000 a year.

QUANTITY OF WATER REQUIRED.

The census of 20th January, 1897, gives the following information for British Kowloon :—

Civil Non-Chinese land population	716
Do. Chinese do.	26,442
Floating population	7,624

Of the 26,442 Chinese in British Kowloon, some are in outlying villages, which are beyond the range of any reasonable distribution system. These, however, form a very small proportion of the whole and may be neglected.

The Military and Naval population, allowing for the barracks in course of erection at Gun Club Hill, may be estimated to be :—

European,	300
Asiatics,	1,200

In the New Territory, Kowloon City and Sham-Shui-Po, with estimated populations of 2,000 and 1,500 respectively, should be included in the scheme.

With the above data, taking into account the increase which has occurred in the two years which have elapsed since the census was taken, the present population and water supply required may be estimated as follows:—

<i>Kowloon Peninsula.</i>	<i>Population.</i>		<i>Gallons per head.</i>		<i>Total gallons per day.</i>
Civil European, land,	1,000	×	20	=	20,000
Do. Chinese, do.,	30,000	×	10	=	300,000
Do. do., floating,	8,000	×	5	=	40,000
Naval and Military, European,	300	×	20	=	6,000
Do., Asiatic,	1,200	×	10	=	12,000
<i>New Territory,</i>	3,500	×	10	=	35,000
	<u>Total,</u>				<u>413,000</u>

Taking the average, this will give about 9 gallons a head, which cannot be considered an excessive supply for domestic purposes alone, and it must be borne in mind that the Dock Company's Hung Hom Establishment takes 20,000, and the Wharf and Godown Company's 15,000 gallons a day. In fact, the supply can only be kept within these limits by strict supervision, by metering all private services, and by allowing no private services in Chinese houses. In proof of this it may be stated that during 1898 the domestic supply in Victoria, where water is laid into Chinese houses, amounted to 13.5 gallons per head, while in Kowloon, where it is not, the supply during the same period was at the rate of 6.1 gallons. This latter amount will, no doubt, be exceeded when the distributory system is made equal to the requirements and an ample and constant supply ensured.

It is impossible to estimate the probable increase of a population of this sort—according to the census returns of 1891 and 1897 it increased 33 per cent. in 6 years—and in view of the fact that the works will probably take 3 or 4 years to complete, it is proposed to provide a fair margin over present requirements and to lay out the works in such a way that they may be extended without stoppage of the supply.

Taking all things into consideration it appears advisable to provide at once for a supply of not less than 500,000 gallons a day.

The existing supply amounts to between 200,000 and 300,000 gallons a day.

SUPPLY OBTAINABLE FROM A CATCHMENT AREA.

In Mr. COOPER's report on the Water Supply of Victoria, 1896, the following figures are given as a basis for calculating the yield of a catchment area:—

Rainfall from May to August, 44 inches, of which 50 per cent. is available.

Rainfall from September to April, 20 inches, of which 33 per cent. is available.

These figures are the results of the experience gained in working the Tytam and Pokfulam reservoirs.

The gathering grounds on the hills at the back of Kowloon Peninsula are very similar to those at Tytam and Pokfulam, and as the rainfall is not likely to differ largely, the above figures may safely be taken as a basis of calculation. By doing so it will be found that to supply 500,000 gallons a day a collecting area of about 300 acres is necessary.

AVAILABLE SOURCES OF SUPPLY.

An examination of the country from Li-Chi-Kok to the Peninsula east of Kowloon Bay has resulted in 5 available sources of supply being found, in two of which good reservoir sites exist. These are shown on drawing No. 1, and details of the Reservoir Sites from surveys by Mr. XAVIER on drawings Nos. 2, 3 and 4.

Source No. 1—Contains a reservoir site commanding a drainage area of 152 acres, which can be increased by means of a short catchwater to 333 acres. To equalize the rainfall on this area a reservoir of not less than 93,000,000 gallons capacity should be provided. The site surveyed will give, with a dam 65 feet in height, a storage capacity of 120,000,000 gallons. The lowest draw off would be 390 feet above Ordnance datum, and the supply obtainable from the drainage area of 333 acres would be 590,000 gallons a day. This can be further increased by additional catchwaters to the east on both sides of the Shatin Valley.

Source No. 2—Also contains a reservoir site which commands a drainage area of 219 acres. To equalize the rainfall on this area, storage would be required for 62,000,000 gallons, but a reservoir capable of containing 106,000,000 gallons can be constructed with a dam of only 50 feet in height. In order to utilize the site to its full extent, therefore, a catchwater should be constructed to intercept a large stream to the westward, thus considerably increasing the drainage area. Disregarding this, the natural drainage area of 219 acres will yield a supply of 390,000 gallons a day.

Source No. 3.—The streams above Cheung Sha Wan, now being intercepted for a temporary supply, can be picked up and connected to the main, but there is no possibility of constructing a reservoir to impound water. The supply in winter would probably be about 50,000 gallons a day, and in summer 200,000 to 300,000 gallons, making a valuable addition to the supply in a dry year.

Source No. 4.—A considerable stream flows down the valley to the north-east of Kowloon Bay, but here again there is unfortunately no site for a reservoir. The stream, however, might be intercepted in a similar manner to that proposed for the streams behind Cheung Sha Wan.

Source No. 5.—Immediately below the Sai-kung road near the point where it crosses the water-parting between the valleys draining to east and west is a small reservoir site with a catchment area of 100 to 200 acres. This may be reckoned to yield a supply of about 200,000 gallons a day.

Summarizing these, the total supply available from all sources is as follows:—

	<i>Gallons per day.</i>
No. 1,	590,000
„ 1 (extension to east),	200,000
„ 2,	390,000
„ 2 (extension to west),	100,000
„ 3,	100,000
„ 4,	150,000
„ 5,	200,000
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	Total,.....1,730,000
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PROPOSED WORKS.

To meet present requirements, Source No. 1 should be utilized and a storage reservoir constructed there, all cultivation being stopped within the drainage area. As already shown this will yield a supply of 590,000 gallons a day. The reservoir should be connected by a cast iron main to Filter Beds to be constructed at a suitable elevation on the ridge above Cheung Sha Wan and from there a cast iron main laid in the new Táipó Road would convey the water to a Service Reservoir to be constructed on the hill to the north of the village of Kowloon Tong. This service reservoir would be connected to the existing distributing system which should be extended to Kowloon City on the east and to Tai-Kok-Tsui and Sham-Shui-Po on the west. At Kowloon City a small service reservoir would be required to maintain the supply in case of a breakdown on the 2 miles of main between there and Hung Hom, where a service reservoir already exists.

The present collecting area and pumping machinery should be dispensed with, and the buildings used as a workshop, space for which is now much needed. Probably one half of the syphon pipes (7" and 6") might be taken up and used again. Full advantage would be taken of the existing distribution system and service reservoirs, the only works to be dispensed with being those in the collecting area and the pumping machinery. The economy to be effected in annual expenditure by saving the cost of pumping will fully justify this, even if the machinery cannot be used for other purposes.

As the demand for water increases, collecting area No. (1) should be extended by catchwaters to the east, and collecting areas Nos. (2) and (3) on drawing No. 1 should be utilized. The total estimated supply available when these additions have been made will be 1,380,000 gallons a day. Before this consumption is reached, however, it will probably be advisable to seek for a new source of supply on the hills to the north-east of collecting area No. (1), crossing if necessary to the eastern slopes of Tai Mo Shan. The supply obtainable from sources Nos. (4) and (5) on drawing No. 1 is so limited that, if it appears at all probable that the consumption of Kowloon will eventually exceed these, it would be better policy to at once adopt a larger scheme, reserving these small areas for any industrial enterprises that may be started in Kowloon Bay.

PARTICULARS OF WORKS PROPOSED TO BE CARRIED OUT TO MEET PRESENT REQUIREMENTS.

Storage Reservoir.—As good building stone does not appear to be abundant on the site of Reservoir No. 1, it is proposed to construct an earthen dam with central puddle wall on the lines of that at Pokfulam, a work which has proved very satisfactory and required little or no repairs. An earthen dam would probably be completed more quickly than one of masonry, and, the natural drainage area being small, there need be no fear of injury from rainstorms during construction.

The dam will be 65 feet in height from top water level to the present stream bed. Its top will be 10 feet above overflow level and 10 feet wide, the inside slope will be 3 to 1, protected by stone pitching, and outside slope 2 to 1, turfed. The puddle wall will be carried down in a trench to a solid foundation, and up to 3 feet above overflow level.

The overflow will be constructed of masonry and situated at the northern end of the dam. It will be so designed that, with a depth of three feet overflow it will discharge a rainfall of four inches an hour on the natural drainage area (152 acres) and 1½ inch an hour on the area (400 acres)

which it is proposed should eventually be intercepted by catchwaters. A masonry channel will conduct the overflow water clear of the toe of the dam and of the gauge basin. On the overflow provision will be made for inserting planks, by means of which an additional two feet of water may be impounded in favourable seasons, as is now done at Tytam and Pokfulam. The hill road, which crosses the valley in the neighbourhood, will be diverted and carried across the overflow by means of a bridge.

The outlet works will consist of a culvert built in a trench excavated in the solid ground at the northern end of the dam, this will be connected to a valve tower containing the usual stand pipe and three outlet valves at different levels. A small bridge above top water level will give access to the valve tower.

The lowest draw off will be 395 feet above Ordnance datum, top water level at the existing Yau-Ma-Ti service reservoir is 215 feet. Advantage will be taken of the ample head thus available to construct the gauge basin at such a distance below the dam as to intercept all probable leakage.

Catchwater.—The catchwater will be constructed to carry a rainfall of $1\frac{1}{2}$ inch an hour on the drainage area intercepted by it. This amount is seldom exceeded in dry years, and in wet years, when the rainfall is excessive, the surplus will be carried away by suitable overflows. The bottom will be pitched with stone and a small cemented channel left at one side to carry the dry weather flow and prevent its loss by evaporation and leakage. The bank alongside the catchwater will be raised a foot above the level of the overflows on straight lengths, and two feet where sand pits overflows or sharp bends occur. A connection will be provided from the catchwater to the gauge basin below the dam by means of a cast iron pipe, so that it may serve as a clearwater canal after times of heavy rain.

Main to Filter Beds.—From the gauge basin below the dam the water will be conveyed to the Filter Beds by means of a 12-inch cast iron pipe laid along the hill side. This pipe when new will be capable of carrying 1,600,000 gallons a day, and will therefore serve for delivering the entire supply estimated to be obtainable when the whole of the sources described in the first portion of this report are made available. Near the Filter Beds a branch will be left for a future connection to Reservoir No. 2. All available streams will be intercepted *en route*.

Filter Beds.—The only suitable site for Filter Beds appears to be on a comparatively level spot north of the point where the new Táipó Road passes behind the hills above Cheung Sha Wan.

To filter 590,000 gallons a day—making the usual allowance for cleaning beds—an area of about 1,300 square yards will be necessary, and in order to take advantage of the site in an economical manner the beds will be arranged at different levels, which can be done without undue loss of head, owing to the comparatively high level of the storage reservoir. A caretaker's bungalow will be required alongside the beds. If, on detailed surveys being made, the site is found to be large enough, it will be laid out with a view to the addition of further filter beds to deal with the water from the proposed reservoir on site No. 2. Should this, however, be found impracticable, a suitable site for this purpose must be found elsewhere.

Main to Service Reservoir.—From the Filter Beds either a short tunnel will be driven through the ridge, or a pipe carried round it, as may be found the more economical when detailed surveys are made, and a 12" main will then be laid partly below and partly along the new Táipó Road and up the hill to the large service reservoir about to be described.

Service Reservoirs.—The existing service reservoirs are capable of containing only 250,000 gallons, a quantity which has on several occasions been found inadequate to tide over a breakdown, and provision on a much more extensive scale for the storage of water after filtration is urgently required. There is no suitable site for a large service reservoir near the centre of the district to be served, and it has therefore been found necessary to select one on a hill to the north of the village of Kowloon Tong. The reservoir will be circular, 150 feet in diameter and 20 feet deep having a capacity of about 2,000,000 gallons.

At Kowloon City a small reservoir only, say 150,000 gallons capacity, will be required; it will be similar to the existing ones and situated on the hill above the walled city.

Connection to existing Distribution System.—From the Kowloon Tong service reservoir a 12" main will be laid through Mong-Kok-Tsui to connect with the existing 7" main at Yau-Ma-Ti, and a 5" main with 3" and 4" branches will supply Tai-Kok-Tsui and Sham-Shui-I'o. On the eastern side of the Peninsula a 6" main will be carried along the new road to Kowloon City with 3" and 4" branch mains to the large villages of Too-Kwa-Wan and Ma-Tau-Wai. All new mains will have hydrant-branches at distances of 300 feet apart where building is at all probable, and hydrants will be fixed in all built districts.

Fire Hydrants on existing System.—In the original waterworks scheme fire hydrants were omitted, partly on account of the limited supply and partly because most of the houses were situated near the harbour. When the proposed new supply is obtained fire hydrants should be fixed at intervals of

about 300 feet on all mains in the built districts. Owing to reclamation works at Yau-Ma-Ti and Mong-Kok-Tsui the houses will soon be at such a distance from the harbour that little help could be obtained from it in case of fire.

ESTIMATE.

The following is an approximate estimate of the cost of the works described :—

Storage Reservoir,	\$150,000
Catchwater,	6,000
Main to Filter Beds,.....	16,000
Filter Beds and Bungalow,.....	20,000
Main from Filter Beds to Service Reservoir,	72,000
Service Reservoir at Kowloon Tong,	60,000
Connection to and extension of existing distributing system,	55,000
Service Reservoir at Kowloon City,	6,000
Fire hydrants on existing system,	3,000
Purchase of cultivated ground,	5,000
	393,000
Allow for value of machinery and pipes to be dispensed with,.....	13,000
	Total,\$380,000

To make a fair comparison between the cost of this and the cost of a pumping scheme such as that hitherto existing, the annual expenditure on maintenance must be taken into account. If this be capitalized at 5 per cent. we arrive at the following results :—

Existing Works.

Supply,	232,000 gallons a day.
Original cost,	\$ 128,000
Capitalized cost of maintenance,	\$ 120,000
Cost of supply per million gallons, per day,	\$1,070,000

Proposed Gravitation Scheme.

Supply,.....	590,000 gallons a day
Cost of existing works to be utilized,	\$ 90,000
Estimated cost of new works,.....	\$380,000
Estimated cost of maintenance (capitalized),	\$ 40,000
Cost of supply per million gallons, per day,	\$860,000

The Service Reservoir, Main and Distribution works, though necessary at once, have been designed to meet the requirements of a much larger supply, and it will consequently be found that when the proposed Reservoir on site No. 2 is constructed and the whole of the sources of supply mentioned in this Report are made available, bringing the total supply up to 1,380,000 gallons a day, the cost per million gallons per day will be considerably more favourable.

The total cost for this supply is estimated as follows :—

Cost of existing work to be utilized,	\$ 90,000
Estimated cost of works proposed to be constructed immediately,	\$380,000
Estimated cost of future works,—	
Storage Reservoir,	\$150,000
Catchwater, &c.,	20,000
Main to connect to existing system,	10,000
Filter Beds,	20,000
Extension of distributing system,	30,000
	\$230,000
Capitalized cost of maintenance,.....	\$ 80,000
	Total,.....\$780,000
Cost of supply per million gallons, per day,	\$570,000

The following drawings * accompany this report :—

- No. 1. General Plan showing sources of supply, distribution areas and proposed works.
- No. 2. General Plan of sources Nos. 1 and 2, Scale $\frac{1}{5000}$, showing drainage areas and reservoir sites.
- No. 3. Reservoir Site No. 1, Scale 1 inch = 50 feet, showing proposed dam.
- No. 4. Reservoir Site No. 2.

I have the honour to be,

Your obedient Servant,

LAWRENCE GIBBS, A.M.I.C.E.

8th January, 1900.

The Honourable
DIRECTOR OF PUBLIC WORKS.

(Secretary of State to Governor.)

HONGKONG.
No. 297.

DOWNING STREET,
6th September, 1900.

SIR,

With reference to Major-General GASCOIGNE'S despatch No. 223 of the 18th of May last, I have the honour to transmit to you for your information a copy of a letter from Mr. O. CHADWICK to the Crown Agents for the Colonies, enclosing a Report on the proposed scheme for a water supply for Kowloon.

2. The financial aspect of this scheme must be considered in connection with the Estimates for 1901.

I have the honour to be,

Sir,

Your most obedient,
humble Servant,

J. CHAMBERLAIN.

Governor

SIR HENRY A. BLAKE, G.C.M.G.,
&c., &c., &c.

(Mr. Chadwick to Crown Agents.)

NO. 7, CARTERET STREET,
WESTMINSTER,
22nd August, 1900.

Re Hongkong—Water Supply of Kowloon.

GENTLEMEN,

In accordance with instructions contained in your letter of 29th June, 1900, I beg to submit a report upon a proposed scheme of water supply for Kowloon.

I am of opinion that the scheme is sound in principle and is one that should be carried out forthwith. There are, however, some minor matters of detail to which I refer in my report, which require reconsideration. They are, however, matters which require for decision more local knowledge than I possess at present. My remarks must therefore be regarded as suggestions rather than instructions.

I have, &c.,

OSBERT CHADWICK,
per W. J. HARRISON.

REPORT ON WATER SUPPLY OF KOWLOON.

BY

OSBERT CHADWICK.

Existing Works.

1.—The existing works were projected by myself whilst in Hongkong in 1889-90. The main feature of their design was to obtain a supply, from sources within the then limits of British territory. Now that the hills inland, have been annexed, it is but reasonable that an augmented supply should be obtained from them by gravitation.

Feasibility of Proposed Works.

2.—The proposed works are quite feasible, and may safely be sanctioned, as regards the first instalment, providing 590,000 gallons a day. The gathering grounds of sources 1 and 2 should be forthwith expropriated, and no buildings should be permitted upon them, so No. 2 will be available for future extensions.

As regards the other sources, the Government should acquire a lien upon them, so that they may be acquired on reasonable terms if required in future.

Probable Supply.

3.—The probable supply is correctly estimated, according to the data obtained by actual experience in Hongkong, on the assumption that the rainfall is the same in amount and distribution on the mainland, as it is in Hongkong. It is probable that such is the case, but not absolutely certain. Short of actual measurements, made over a number of years, there is no means of predicting, with certainty, the actual quantity of water which will flow off from a given gathering ground. To make such prolonged measurements would unduly postpone the construction of the works. The only plan is to base the calculation upon the Hongkong data. In my report of 17th September, 1896, I analysed these data using a train of reasoning somewhat different to that adopted by Mr. COOPER, in his report of 1896, and arrived at the following conclusions. They agree closely with Mr. COOPER's conclusions.

(a.) That the minimum annual *available* rainfall amounts to 30 inches.

(b.) Therefore a gathering ground of 1,000 acres will afford 1,860,000 gallons per diem in the year of minimum rainfall.

(c.) That to provide this quantity 200 days' storage will be required.

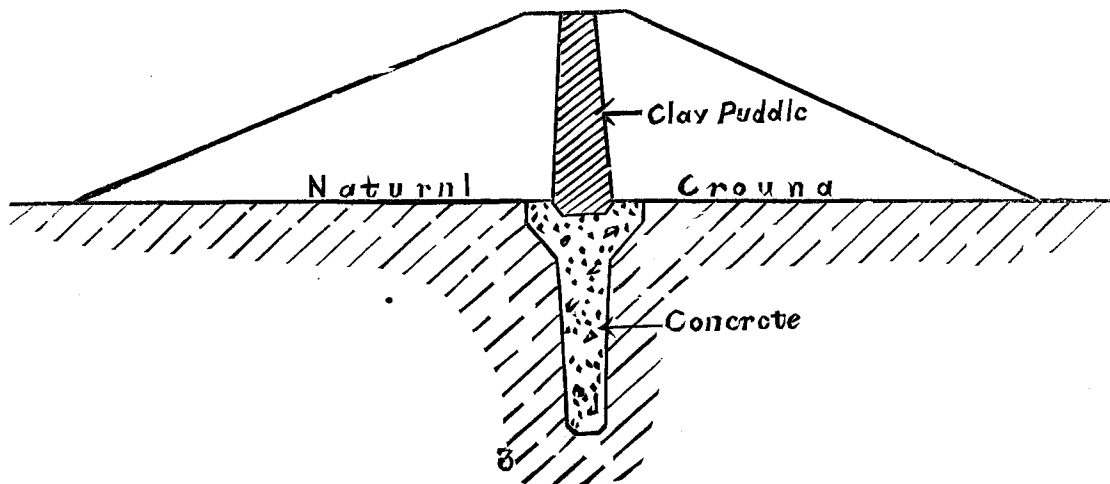
The gathering ground of proposed source No. 1 is 333 acres, or one-third of 1,000. A supply of $\frac{1,860,000}{3}$ 620,000 gallons a day may, therefore, be expected, and to secure it, a reservoir capacity of 124 millions of gallons will be required. The desired immediate supply is only 413,000 gallons, and the proposed reservoir contains 120,000,000 gallons. According therefore to Hongkong data there is a liberal margin; and there can be little doubt that a bountiful supply will be obtained. The actual amount must remain in uncertainty until the works are completed. It is desirable that rain gauges should be forthwith erected on each of the proposed sites. Observations should be commenced at once. Comparison of the first year's observations with present and past observations at the Observatory, will afford a means of correcting the estimate of probable yield.

Material of Reservoir Dam.

4.—It is proposed to make an earthen dam with a puddle wall in the centre in the ordinary manner, at sources Nos. 1 and 2, on account of apparent scarcity of good building stone. I must, however, record my opinion that a masonry or concrete dam, like that at Tytam, will be far preferable, even if it cost somewhat more. With a masonry dam, a leakage merely amounts to a loss of water. With an earthen dam, it may result in destruction. I therefore recommend that careful examination be made for building stone, before earth is decided upon as a material. I have never visited the mainland, beyond the former frontier; but I presume that the geological formation is similar to that of Hongkong, where solid masses of granite are found imbedded in decomposed granite; but not visible at the surface. If I remember rightly, in the Tytam Valley, in its original condition, very little rock appeared at the surface; yet plenty of stone was obtained. It must be clearly understood that, with care, a thoroughly efficient and safe reservoir can be constructed. I merely assert that, if stone can be obtained, masonry or concrete is a preferable material.

Puddle Trench.

5.—I am of opinion that, unless the most excellent puddle clay is readily obtainable, a concrete stop wall is preferable to a puddle wall. At any rate it is good practice to fill in the puddle trench below ground with concrete, using puddle only in the bank, thus:—

*Valve Well and outlet arrangements.*

6.—The proposed arrangement of the outlet culvert and valve well does not entirely commend itself to my judgment. It would be more in accordance with modern practice to remove it from beneath the bank, constructing it as a tunnel. In determining its section, provision should be made for carrying off the perennial flow of the streams, and even of considerable floods, during construction. It will scarcely be possible to complete the dam during one dry season. If it be not carried up to the full height before the first monsoon so that the permanent bywash can come into play, then during the monsoon the incomplete dam may be overtopped, and if earth be the constructive material, considerable damage will result. One of the advantages of concrete is that if an incomplete dam is overtopped, no serious damage ensues. If a masonry dam is adopted, the arrangement at Tytam may be followed.

Size of By-wash.

7.—The size of overflow should be proportioned to the area of gathering ground in the ratio which obtains at Tytam. This sufficed to carry off the extraordinary flood of 1889, one that is not likely to be exceeded. According to the figures given in the report, the area of overflow will probably suffice.

Filtration, Service Reservoirs, and Distributary-system.

8.—The proposed arrangement of filter beds and service reservoirs is, as far as can be seen from the plans, thoroughly sound; also the proposed distributary-system.

Abandonment of old works.

9.—The existing works will doubtless be abandoned ultimately, if for no other reason, because the gathering ground will be wanted for occupation. Mr. GIBBS in his report lays stress upon the saving that will be effected by the substitution of gravitation for pumping. I think he has scarcely made enough provision for the cost of filtration which is required in the case of the gravitation supply, but not in the case of the existing works. I do not think that it would be prudent to dismantle the old works until the new works have been in operation for some years, so that their actual yield will have been ascertained experimentally. It is to be remembered that all calculations of supply are based on the assumption that the rainfall and flow-off is identical with that which obtains in Hongkong—an assumption that is probable, but not certain.

By-pass Channel.

10.—In the description of the Reservoir, I see no mention of a by-pass channel or pipe for carrying the water of the tributary streams direct to the filter beds, without passing through the body of the reservoir. This arrangement was found to be necessary in the case of the Pokfulam reservoir, and afforded the means of maintaining a supply of filtered water during heavy rain. It was found that after a flood the reservoir remained for a long time so turbid as to render the water unfilterable, whilst the tributary streams cleared rapidly after the cessation of rain.

Conclusion.

11.—In conclusion, I would state that, in my opinion, the project is one that should be carried out at an early date. Some of the details of the design require re-consideration. The principal point to be decided is the feasibility of substituting a masonry for an earthen dam. To determine this some trial pits might be sunk, both on the site of the proposed reservoir and in the body of the reservoir.

17th August, 1900.

Public Works Department.

PUBLIC WORKS OFFICE,
HONGKONG, 12th December, 1900.

KOWLOON WATER SUPPLY.

SIR,—Referring to C.O.D. $\frac{297}{1900}$, I have the honour to report further on the proposed New Water Supply for Kowloon with special reference to Mr. O. CHADWICK'S report.

2. Care will be taken to prevent the opening for cultivation of any more land in the gathering grounds, and early next year the area under cultivation will be surveyed and purchased from the natives. There are no buildings in the drainage areas, and none will be permitted. The uncultivated land will probably turn out to be Crown property, so far I am not aware that any claim to it has been put forward.

3. There is every reason to believe that the rainfall in this valley is quite as much as in British Kowloon. Being nearer the Tai-Mo-Shan range, which is the highest land in the New Territory and has peaks over 3,000 feet high, it is probably greater. As soon as a bungalow is built for the officer who will have charge of the work, a rain gauge will be established and steps will be taken to gauge the streams in the driest weather next year.

4. I entirely concur with Mr. CHADWICK as to the advantages a masonry or concrete dam possesses over an earthen one, and after a further careful examination of the ground, have found an excellent site for a masonry dam 600 feet lower down the stream than the site proposed by Mr. GIBBS for the earthen dam and 30 feet below it in level. At the site I now recommend adopting, two other considerable streams have joined that intercepted by Mr. GIBBS' dam, the combined waters passing through a narrow cleft over solid hard rock. It is evident that sufficient good stone for the dam can be obtained in the vicinity. The geological formation is similar to Hongkong and granite boulders in decomposed granite are plentiful.

5. By placing the dam at this lower site, the necessity for a catchwater is done away with for some years to come, as the drainage area is increased from 333 acres to 417 acres. With a minimum rainfall of 30 inches on this area, we may expect to obtain a supply of 775,620 gallons daily. I propose at first to construct at this site a dam 80 feet high with a top water level of 73 feet; this will impound 152,000,000 gallons. As the demand increases the dam can be raised 20 feet, thereby increasing the storage to 310,000,000 gallons, while 100 acres can be, when necessary, brought into the drainage area by a catchwater from No. 2 Reservoir site, increasing the collecting ground to 517 acres and the supply to 961,620 gallons daily. There is reason to expect from the rapid growth of British Kowloon that in ten years' time all this will be required.

6. A very great advantage connected with this lower site is the fact that a natural spill or byewash exists at the point marked on plan "overflow" which is 437 feet O.D. or 82 above the B.M. in the bed of stream at the new site for the dam. In this narrow saddle there is abundance of rock visible on the surface, and a rapid fall to the valley on the west, a better position in every way for a spill water could not be found.

7. By raising the masonry dam to the same level as the originally proposed earthen dam, I estimate that the reservoir would contain 310,000,000 gallons, but while designing the dam with a view to its ultimately being raised to that level, I would at first only provide for a height of 80 feet, or to O.D. 432. At the same time the site of the byewash would be cleared and levelled and the foundations laid of the waste weir, to be hereafter raised.

8. The level of the bottom of the stream at the point selected for the centre of the dam is 355 feet above O.D., but owing to the rapidness of the fall for a short distance above, very little storage will be lost by making the solid concrete foundations for the dam up to 10 feet above this B.M. I would propose cutting out all fissured, soft, or doubtful looking material, from the bottom of the stream, and doing a certain amount of benching in the bottom and sides, so as to form a good key for the concrete, and then filling up to 365 O.D., with good cement concrete in mass for the full width

and some feet over of the base of the dam. On this base I would construct the base of the Valve Tower and out-let culvert in ashlar masonry in cement, carrying up the dam as far as practicable during the dry months of the year before the rains set in in April or May, when the stream in flood could pass over the work without causing any damage.

9. When this scheme is carried to completion, and the dam raised to its full height, Kowloon will have a storage reservoir containing 310,000,000 gallons of water, with ample head after passing through the filter beds, to command the highest points in the peninsula, and the laying out of building areas and encouragement to Chinese to build and settle on British soil can go on with confidence as to the supply of water.

10. I forward a tracing for transmission to Mr. CHADWICK shewing position of proposed new site for dam and spill, and contour of drainage area.

I have the honour to be,

Sir,

Your obedient Servant,

R. D. ORMSBY,
Director of Public Works.

The Honourable

THE COLONIAL SECRETARY.

GOVERNMENT NOTIFICATION.—No. 61.

Notice is hereby given that Messrs. MEYERINK & Co. and Messrs. W. & C. DUNLOP have complied with the requirements of Ordinance 18 of 1898, for the registration in this Colony of their Marks No. 111, as applied to Cloths and Stuffs of Wool, Worsted or Hair, and Cotton Piece Goods of all kinds, in Classes 24 and 34, and that the same have been duly registered.

By Command,

J. H. STEWART LOCKHART,
Colonial Secretary.

Colonial Secretary's Office, Hongkong, 26th January, 1901.

GOVERNMENT NOTIFICATION.—No. 62.

Notice is hereby given that Messrs. ARTHUR GUINNESS & Co., LIMITED, of Jame's Gate, Dublin, Ireland, have complied with the requirements of Ordinance 18 of 1898, for the registration in this Colony of their Mark No. 112 as applied to Stout in class 34, and that the same has been duly registered.

By Command,

J. H. STEWART LOCKHART,
Colonial Secretary.

Colonial Secretary's Office, Hongkong, 1st February, 1901.

GOVERNMENT NOTIFICATION.—No. 63.

Notice is hereby given that Messrs. S. KUTNOW & Co., LIMITED, of 41, Farringdon Road, London, England, have complied with the requirements of Ordinance 18 of 1898, for the registration in this Colony of their Mark No. 113 as applied to chemical substances prepared for use in medicine and pharmacy in class 3, and that the same has been duly registered.

By Command,

J. H. STEWART LOCKHART,
Colonial Secretary.

Colonial Secretary's Office, Hongkong, 1st February, 1901.