Report on the works of sewerage and drainage proposed for the town of Cannes, France (Alpes Maritimes) / by Douglas Galton.

REPORT

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WORKS OF SEWERAGE

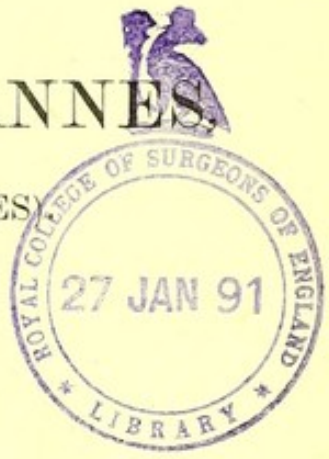
AND

DRAINAGE

PROPOSED FOR

THE TOWN OF CANNES,

FRANCE (ALPES MARITIMES).



BY

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REPORT.

THE letter from the Mayor of the town of Cannes, dated the 22nd of November, 1882, requested me to visit the town of Cannes, and to report,—

1. Upon the works of Main Sewerage and Drainage which have been executed at Cannes, or which are projected; and
2. Upon those which I consider to be indispensable.

Having visited the town of Cannes, and having carefully examined the several conditions which affect the important problem upon which my advice has been asked, I present the following Report:—

1. *Preliminary Observations.*

The old town of Cannes originally occupied the steep sides of Mount Chevalier, and the flatter part immediately to the eastward as far as the Rue Rougière. Beyond this the present town has spread eastward and over the space between the railway

and the sea. The town is about 450 mètres wide at its widest part and extends along the sea for 1,700 mètres, from the Quai St. Pierre to the Promontory of the Croisette.

In the town proper the streets are regular, and the problem of sewerage may, therefore, be comparatively simple.

Outside this area the ground is very hilly.

Between the eastern boundary of the Commune and the Plaine de Laval on the west, the country is intersected by a series of *vallons* running down to the sea, each forming the bed of a stream, which brings down rain-water from the hills above.

These streams are as follow, beginning on the east:—

Discharging into the Golfe Juan :—

1. The Mauvarre, which forms the boundary of the Commune and of the hill of the Californie on that side.
2. Ruisseau de la Californie.
3. Ruisseau de Cros Vieil.

Discharging between the Promontory of the Croisette and Mount Chevalier :—

4. Ruisseau de la Baume.
5. Ruisseau des Gabres.
6. Ruisseau de la Foux, which unites the Ruisseau de la Lèpre and the Ruisseau de Peyrière, and brings down the storm-water from Cannet.

7. Ruisseau du Châtaigner.
8. Ruisseau du Poussiat.*
9. Ruisseau de la Ferraye.*

The other streams are :—

10. Ruisseau du Riou.
11. Ruisseau Provençal.
12. Ruisseau Girard.
13. Ruisseau de Pierre Longue.
14. Ruisseau de Font de Veyre.
15. Ruisseau de Roquebillière, which discharges close to the Château de la Bocca.

The hills of the Californie, situated on the east, and the Croix des Gardes, situated on the west, of the town of Cannes, are of primary rocks; the *vallons* which emanate from these hills are very steep; there is generally more or less water in the Riou, but the beds of the other streams, except in times of rain, are usually dry.

The main valley between these hills, extending from the town of Cannes towards Cannet, is of magnesian limestone and argillaceous soil; and in the Châtaigner and La Foux, which drain this valley, there is a constant stream of water.

The distance from the Mauvarre to the Château de la Bocca is nearly 6,000 mètres, and thus these streams average a distance of about 400 mètres apart along the shore. In the town, from the

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* These two minor streams have been covered for nearly their whole length, and pass into the harbour near the Quai St. Pierre.

Promontory of the Croisette to the Quai St. Pierre, they average a distance of 300 mètres apart, the greatest distance being between the Ruisseau des Gabres and the Ruisseau de la Foux, which is nearly 700 mètres. It is to be observed, however, that a Commission which was recently appointed to inquire into the causes of the inundation which occurred on the 27th of October, 1882, has reported that the Ruisseau de la Foux is not of sufficient capacity to carry off the storm waters which may flow into it, and has recommended the construction of a second channel from the Octroi on the Boulevard du Cannet, crossing the town parallel to La Foux, which might be made to discharge into the sea between Les Gabres and La Foux.

The community of Cannes has increased in recent years with great rapidity. In the area outside the town, Villas and Hotels have been built without regularity, and without much care as to the relative positions of the houses, or as to their interference with the wants of neighbouring houses, or as to the roads by which they have to be approached.

Farm-houses and cottages have been converted into Villas, the additions being often placed over the old farmyard, regardless of the sanitary dangers thus entailed. The country paths without much modification have also become roads.

The result of these changes is that the whole

of the hilly part of the Commune is dotted about with Villas and Hotels, rising one above another, which are often below the levels of the roads which give access to them.

The fouled water which has been used in Villas or Hotels at high levels may, therefore, often find its way into and pollute the subsoil of a neighbour on a lower level, unless special arrangements have been made for its removal.

This evil did not frequently arise so long as the number of houses and Villas was limited, and so long as they stood at considerable distances apart; but the increase of population and the extension of building in the last few years has brought many of the Villas and Hotels into very near proximity, and, consequently, a class of dangers which did not formerly exist has now sprung up.

2. *Population of Cannes.*

The increase of the population of Cannes is apparent from the following figures:—

Date of Census.	According to Sex.		According to Nationality.		Total.
	Males.	Females.	French.	Foreign.	
January 11, 1877 ...	6,854	7,168	11,225	2,797	14,022
December 18, 1881...	9,813	9,442	13,194	6,061	19,255

The total number of houses in the Commune of Cannes, at the Census of December, 1881, was 1841, of which 525 were Villas, and 71 Hotels.

It will be seen that there is a large foreign population. This consists partly of the well-to-do classes, occupying Villas and Hotels, who come to Cannes either for the pleasure of the climate or the necessities of health; and there are also a very large number of workmen, chiefly Italians. In 1881-82 the construction of the new Boulevard brought a large additional number of this class into Cannes. Many of these would often club together to obtain lodgings and live in one room, under unsatisfactory conditions as to health and morality.

There have thus been special conditions existing at Cannes during the last few years, which render it difficult to estimate the healthiness of the locality from the local death-rates, in addition to the usual elements of disturbance which occur in all health resorts.

3. *Rainfall of Cannes.*

The climate of Cannes may be considered dry, in so far as the number of days on which rain falls is concerned; but, according to Dr. de Valcourt's observations, the average quantity of rain which falls is about 900 m.m. = 35·43 inches, which exceeds that of Paris or of many parts of England.

This rainfall may be divided between the seasons as follows, viz. :—341 m.m.=13·4 inches in winter; 239·6 m.m.=9·4 inches in spring; 72·7 m.m.=2·85 inches in summer; and 348·7 m.m.=13·7 inches in autumn.

The rainfall in different years also varies considerably; for instance, in 1875-6 the rainfall of the whole year only amounted to 588 m.m.=23·14 inches; whilst in 1872-3 there fell 1,679 m.m.= 66·09 inches, of which 523 m.m.=20·59 inches fell in October.

This quantity fell on nineteen days, on one of which 91 m.m.=3·58 inches fell; and on two other days the quantity exceeded 60·4 m.m.=2·5 inches; and in November of the same year rain fell on seven days. There then fell 101·8 m.m.=3·97 inches, of which there fell more than one-third on one day, or 49·5 m.m.=1·92 inches; and in December of that year there fell 343·3 m.m.=13·53 inches, on thirteen days, of which more than one-fourth fell on two days, and nearly one-half on four separate days.

The average number of days on which rain falls during the six winter months from November to March is stated by Dr. de Valcourt to be 38 out of 180, as compared with 97 in Paris.

Thus, whilst the whole amount of rainfall is large, it falls on comparatively few days; and it flows off

with great rapidity by means of the numerous *ruisseaux*.

4. *Water Supply of Cannes.*

Cannes is supplied with water by means of a canal or conduit, which brings water from the Siagne, from St. Césaire, situated to the north-west of Cannes, to the hills above and behind Cannes, whence it is supplied to all houses in the town and commune of Cannes, to Cannet and to Vallauris.

The canal at the eastern extremity of the commune of Cannes is about 166 mètres above sea-level. The water of the Siagne is clear and good. In times of severe storms, however, it becomes discoloured, and the water taken from the canal at such times is passed over a rough filter-bed of stones to remove the sediment. The discolouration of the water in the Siagne does not often last for more than a few hours; and on occasions of great discolouration it is not allowed to pass into the canal.

An analysis of the canal water by M. Audisson showed that it contained per litre, magnesia salts, 0·0442 grammes; carbonate of lime, 0·0361 grammes; sulphate of lime, 0·0350 grammes.

The canal is in an open aqueduct, which is not fenced in, and is, therefore, accessible to any one.

It is, however, carried at a level generally above the habitations of the population, and through a district where there is little cultivation.

M. Mavarre, the Directeur of the "Canal de la Siagne," informed me that the volume of water which the canal, without material alteration, is capable of supplying, is as much as 80,000 c.m. per day, and that with a moderate outlay this volume could be nearly doubled.

At the present time the canal brings 25,000 c.m. per day, which would give 1,250 litres=250 gallons per head of the population of 20,000 persons.

Of this amount, 15,000 c.m. is utilised by the inhabitants of the town and commune of Cannes.

The remainder flows to waste down one or another of the *ruisseaux*.

Out of this amount of 15,000 c.m., which is equivalent to 173 litres per second, the administration takes, for public service, 5,000 c.m., equivalent to 58 litres per second. The public service supplies 90 "bornes fontaines," which are kept continually flowing; and it provides water for 350 hydrants for watering the streets and roads.

The water from the canal is furnished to the inhabitants either by measurement of so many cubic mètres of water per day, through a gauge-pipe, or else by what is termed the *robinet-libre*, which is a constant supply through a pipe of a certain size, for

which a fixed price (25 francs a year) is paid; and this form of supply is adopted by many of the smaller class of households for use in the kitchen, &c.; and where there are water-closets in such households, a *robinet-libre* is taken for this service, in addition to that for the other house supply.

The total number of houses in the commune of Cannes is 1,841. The number of houses which receive the water of the Canal de la Siagne is 1,400. Several of the remaining 441 depend for their supply upon the "bornes fontaines" already mentioned.

There are some wells; and some houses possess supplies of water derived from springs flowing from the sides of the hills, but for reasons which will be mentioned hereafter the well-water is liable to pollution, and the facilities afforded by the Canal de la Siagne for the supply of water are so great, that it may be looked upon as the principal source of supply, which has to be considered with reference to the removal of the waste water.

The 15,000 c.m. of water which Cannes receives is delivered in the following proportion to different parts of the area:—

1. To the houses to the east of Cannes, from the boundary of the Commune at the Mauvarre to the level crossing by the railway of the Rue d'Antibes	3,660	cubic mètres of water per day, equivalent to 42 litres per second

2. To the town of Cannes, between the stream of the Riou on the west, and the level crossing of the Rue d'Antibes, by the railway, on the east, including the amphitheatre formed by the hills of the Croix des Gardes and the hills behind Cannet and the Californie, as far as the stream of the Gabres	8,900 cubic mètres per day, equivalent to 103 litres per second.
3. To the west of Cannes, between the stream of the Riou and the abattoir near the Bocca	1,975 cubic mètres per day, equivalent to 23 litres per second.
These quantities, added together, make a total of	14,535 cubic mètres, equivalent to 168 litres per second.

This volume of water calculated upon the population of 20,000 would give 726 litres per head per day. But a considerable quantity of the water supplied to Villas is used for gardens and other purposes, and would not pass into the drains.

The experience of towns in England shows that it is very rarely that so much as 250 litres per head of the population flows away by means of the drains.

One half of the water which passes to the Sewers flows away in eight hours,—that is, between about six o'clock a.m. and two o'clock p.m.

The project for the sewerage of the town by MM. Bruniquel and Vigan appears to be based upon a population of 30,000 inhabitants, and upon a daily consumption of 150 litres per head.

Considering the abundant water supply at Cannes, it would probably be more prudent to assume 250 litres per head of the population per day, which would amount to 7,500 c.m., of which half would run off in eight hours.

5. *Existing Arrangements for Sewerage, Drainage, and Removal of Refuse.*

A. *Sewerage and Drainage.*—The *ruisseaux* are the natural channels, and must so remain, for the removal of the rainfall, but they have also been utilised up to this time as the principal means of drainage for the domestic water. The beds are, however, rocky, rough, uneven, and encumbered with stones; therefore, in dry periods, the refuse water passed in has frequently stagnated and caused inconvenience.

In the town area the natural water-courses have been supplemented to some extent by Sewers: the most important of these Sewers commences in the Rue d'Antibes at the Ruisseau of La Foux, passes under the Châtaigner, and along the Quai St. Pierre, and terminates at an outfall outside the Mole near the lighthouse.

This Sewer was constructed about ten years ago. It is oval in shape, the size being 1·00 mètre by 1·70 mètre, and it has several outlets to the sea for storm-water. The inclination is ·0015 m. per mètre : at the outlet its invert is 0·40 mètre below sea level.

In storms the mouth of the Sewer becomes encumbered with sand and stone, and requires to be cleaned by hand labour.

The domestic water, or *eaux ménagères*, in the town, which includes water from kitchens, from washing, and from baths, &c., generally passes from the houses down the rain-water pipe and under the pavement into the side gutters of the streets, and thence to the nearest inlet into a Sewer, or to a neighbouring Ruisseau.

In the case of some large Hotels in the town of Cannes, which have a garden, and where there are no drains near, the domestic water is taken to a well, termed a *puit perdu*, which is an excavation of about 12 feet deep in the ground, filled in with stones ; from this the water percolates into the adjoining subsoil.

In the district outside the town, where there are Villas, the *eaux ménagères* are often taken to a *puit perdu* in the garden, and then allowed to dissipate themselves in the soil, which gradually

becomes permeated with offensive matter; or if there is a *ruisseau* near, they are turned into the *vallon*. In the case of these *vallons* in which no stream of fresh water flows, or where the bed is rough and uneven, the waste water stagnates in pools on its way down, and is liable to putrefaction. The experience gathered from towns in England which have cesspits, shows that the sewage of a town without water-closets, and where fœcal matter is removed by hand, the overflow only passing into the drain, is nearly as full of putrefying organic matter as the sewage of towns where the fœcal matter is removed by water, and all sent to the Sewer.

When the domestic water is poured out continually on to the same spot, the ground soon becomes offensive, unless its extent and the cultivation upon it are sufficient to allow of absorption by vegetation.

It is desirable for these reasons that drains should be provided for the waste domestic water from Houses, Villas, and Hotels outside the town, and that it should not be allowed to escape in the present haphazard way into the roads and into the *vallons*, and so pollute them.

Fœcal matter is not allowed, by the Cannes regulations, to be turned into the drains, but is dealt with in the following manner :—

In the old part of the town the older houses have no cesspits; but the fœcal matter is deposited in earthenware vessels, which, when filled, are emptied into small barrels, and these barrels, when full, are removed to the country, to be used for manure.

In the newer parts of the town, *i. e.* that part or those houses which have been constructed during the last fifteen or sixteen years, each house is provided with a cesspit or fosse. This fosse is below the level of the street; but frequently it stands up above the level of the floor of the basement.

Where there is a garden, as is often the case with Hotels, it is placed in the garden. The fosse is required to be water-tight; and in those cases where its sides are above the basement-level, any leakage would show itself at once.

These fosses vary in size, but probably contain from 12 to 14, or even 16 cubic mètres.

The soil-pipe from the closets to the fosse is generally trapped to some extent. There is also a ventilating-pipe carried up from the fosse to above the roof. These pipes are about 6 inches in diameter (say 0·15 m.).

The prohibition against allowing fœcal matter to pass into the town Sewers and drains applies equally against passing it into the *vallons*.

All the Villas may be said to be furnished with water-closets. The drainage from them is carried to

a fosse, which is sometimes under the house, sometimes in the garden. The fosses are generally ventilated, and by regulation they are required to be water-tight, as already mentioned. Where the gardens are of sufficient size, the fosse is emptied by the proprietor, and the contents used on the garden; but the Villas are now so numerous and so near together that this is not always possible.

The Compagnie des Vidanges has been established for emptying these fosses. They have no monopoly, but if they are employed, the occupier is relieved from any responsibility as to nuisance caused by the emptying. They use the pneumatic process, by which the emptying is effected without much smell. The tube penetrates to the bottom of the fosse, and removes all that is liquid, but leaves the layer of thick and very offensive matter which always forms on the surface of the liquid matter in a cesspit. The company charge for removing the liquid 4 francs per cubic mètre in the town, and in the flat parts adjacent, *i.e.* up to the Peyrière, &c.

The Compagnie des Vidanges will, if required, empty the fosses at the Villas and Hotels outside the town; but when the fosse required to be emptied is situated in the hilly districts outside the town, the charge is increased, viz., to 6 or 8, and even to 10 francs, and in some extreme cases up to 15 francs per cubic mètre, because of the great cost of moving

the steam-engine and heavy tumbrils up and down the hills.

If it is desired, after the liquid sewage has been drawn out, to have the thick matter removed by hand, and the cesspit cleaned, the company do so at a charge of 24 francs additional for each night's work. The company informed me that this was a service which they were not often called on to perform.

The company are unable to utilise the product of the fosses. In consequence of the large amount of liquid, the peasants do not care to purchase it for manure; the distance and hilly roads over which the tumbrils would have to pass to the Plaine de Laval, which is the nearest locality where sewage works could be established, prevent the company from being able to convert it profitably into other forms of manure. The result is that they cart it to the end of the Mole outside the harbour, and turn it through a pipe which delivers it, under water, into the sea. This plan appears to be as free from objection as the existing circumstances will allow.

This large amount of liquid in the sewage is a consequence of the plentiful supply of water. For instance in the Hotels and Villas, Jennings's water-closet pan is frequently adopted, instead of the French plan, which uses less water.

A Jennings's water-closet pan, to act efficiently, requires over 2 gallons of water each time of use,

say 10 litres; therefore a pan will, if used from 100 to 125 times, consume a cubic mètre of water, and a fosse, holding 12 cubic mètres, would require to be emptied, for a family of ten people, once every four or five months; and in the case of Hotels, containing from 100 to 150 people, and even more, a cubic mètre of water per day would be sent into the cesspit,—that is to say, the keeper of a large Hotel in the town would probably have to pay from 1,000 to 1,500 francs a year for emptying his fosse, and a private family as much as from 60 to 100 francs. In the country districts the cost would be much greater. Consequently it is very much to the interest of the occupants of houses, Villas, and Hotels to resort to any available means which enable them to avoid the frequent emptying of their fosses. It is not surprising, therefore, that, although it is not permitted by the regulations to pass the overflow from the fosse either into the drains or into the streams or *vallons*, in many cases there is an overflow-pipe provided from the cesspit either to the town drains or to the *ruisseaux*, or to a *puit perdu* in the garden. The Compagnie des Vidanges complains that the receipts are much diminished by these clandestine proceedings.

The following observations occur upon these arrangements.

The cesspits are a continual source of danger, of

difficulty, and of expense. The retention of a large amount of fœcal matter in a putrefying condition, in close proximity to houses, is most dangerous. The experience of numerous towns may be cited as showing diminished death-rates following on an abolition of cesspits.

The Model By-laws of the Local Government Board for towns in England provide that where there are cesspits they should be thoroughly cleansed once in every three months.

The ordinary difficulties entailed by cesspits are aggravated at Cannes by the almost universal adoption of water-closets of a pattern which consume a large volume of water. By this the fosse is filled much sooner than it would otherwise be. The necessity of constantly emptying is expensive, and there is thus every inducement to provide an overflow. The overflow of this matter into a town drain is dangerous to health, because it is necessarily in a high state of putrefaction; and when turned into the *vallons* it becomes a fertile source of nuisance. When placed in a *puit perdu* in a garden it is liable, by saturating the ground around, soon to become a serious evil.

The retention of fœcal matter under a house or close to it, is always a source of danger, because, however well the walls of a fosse are built, they are formed of materials more or less porous, through

which the gases emanating from putrefying matter are liable to filter.

It is an accepted axiom of sanitary science that if fœcal matter is to be placed in a drain, it must pass at once from the closet, and must not be in a state of fermentation; consequently, the intervention of a fosse between a water-closet and the drain is objectionable.

From these considerations it is evident that if the existing arrangement is to be allowed to continue, an overflow of putrid matter from a fosse should not be permitted under any circumstances. It is also evident that on the ground of health it is desirable that all fosses under houses should be abolished, and that the fœcal matter should be removed at once before fermentation can commence. It may be received in *tinettes*, or it may be carried away by a drain.

Besides the question of health there is the question of economy.

The Compagnie des Vidanges informed me that they remove from 30 to 40 cubic mètres of cesspool matter per night, for 300 nights in the year, from the town area. This amount could be removed by a pipe of 0·05 mètre=2 inches in diameter laid at an inclination of ·01 per mètre (or $\frac{1}{100}$) flowing during eight hours. For the removal of cesspool matter the occupiers of houses pay the Compagnie des

Vidanges from about 36,000 to 48,000 francs a year.

If this sum of money be looked upon as the interest of a capital sum, it would represent, at 5 per cent., from 720,000 to 960,000 francs.

The sanitary objections to retaining the fœcal matter in the fosses do not apply to the use of *tinettes*, which are movable receptacles made of metal, and furnished with a lid capable of being hermetically closed; but the *tinettes* must not be emptied into the drains, nor should any overflow be permitted from the *tinettes*, whilst in use, into the drains.

The Compagnie des Vidanges state that they charge 25 centimes for a *tinette*, which they remove when full. The *tinette* holds 50 litres, and thus the charge for removal by means of *tinettes* would be 5 francs per cubic mètre; so that the removal by this plan would cost a fourth more than the removal from the fosses.

The simplest and most effectual method of sewage removal is to pour it direct into a drain constructed so as to carry it away rapidly.

If drains exist in which water is flowing, the immediate removal of excretal matter by the drain presents no difficulties; the quantity is so small. Each individual ejects on an average 1·5 kilogrammes of excreta, of which 0·15 only is solid. Hence the

total for a population of 20,000 would not exceed 3,000 kilogrammes, which would pass off through the drains, not at once, but gradually, within the eight hours during which the maximum flow of sewage takes place. The fœces would thus average only a few grammes per second, and would cost nothing to remove; whereas, under the present system of removal, if the Compagnie des Vidanges performed the service of emptying all the fosses for the whole population of 20,000, at a cost of 4 francs per cubic mètre, the expense to the community would, at the lowest computation, exceed 100,000 francs a year, which represents, at 5 per cent., a capital sum of 2,000,000 francs.

When it is considered that the volume of water used for domestic supply varies from 150 to 200 litres per person per day, whilst the water used in a water-closet per individual cannot exceed at the most from 5 to 10 litres per day, it will be evident that any drainage arrangements for a removal of the domestic water would amply suffice for carrying off the water from water-closets, if the fosses were abolished and if this water were turned into the drains; and that, since drains are necessary for the domestic water, the removal of fœcal matter in the same drain will be a direct saving to the community of the large amount above mentioned.

It is thus clear that the method of removal is not

economical for the community; and since the fœcal matter is retained until it attains a state of putrefaction, and is then frequently caused to flow into the drains or the *vallons*, the system is eminently dangerous to health.

B. *Removal of Dry Refuse.*—The streets of the town and the roads outside the town, classed according to a certain category, are cleaned by the Service de Balayage daily; the paved streets of the town are washed, and the refuse carried by the water into the Sewers. Macadamised streets are not washed because of the wear of the street occasioned thereby.

The dry refuse of a household, which cannot be passed into the drain, such as *débris de cuisine*, pieces of vegetable and animal matter, dust from sweepings, &c., is removed by the Service de Balayage daily, if placed by the householder on the streets and roads on which the service is performed. But when the house is situated off those roads, the householder must dispose of this refuse as he can, and the system generally in the Villas is to bury it in the garden. Where the gardens around the houses are small, if this system should be continued for a long period, the soil of the garden cannot fail to become saturated with decaying matter, as the process of decay with buried rubbish is comparatively slow, and the pollution of the subsoil will therefore be a continual danger to health.

In cases where space is very limited the refuse is often accumulated in a heap near the house, and then becomes more immediately a source of danger.

In consequence of the rapidity with which the population and the Villas and houses of Cannes are increasing, and the distance between the Villas is being diminished, the continual accumulation of refuse in the soil and around the Villas cannot fail to become more dangerous year by year.

The Model By-laws of the Local Government Board in England require the Local Board to remove the house refuse from off the premises at least once in every week.

It is evident that in the climate of Cannes the removal of refuse should not be less frequent.

The retention of such refuse near houses should be prohibited by regulation. It is probable that an extension of the Service de Balayage could be arranged, which, while requiring some small payment from the occupiers of the Villas, especially those at a distance, would ensure the regular removal of this source of danger to health. This refuse, when removed, must not be allowed to be deposited in places upon which at a future time dwellings may be built, as such a method of proceeding has frequently led to outbreaks of fever.

The refuse should be carted to a properly arranged depôt outside the town, where it can be sorted, and

that part which cannot be utilised as manure or otherwise should be burned in a specially-constructed kiln.

6. *New Works of Drainage which have been commenced.*

1. *For the Town.*—In the spring of 1882 MM. Bruniquel and Vigan prepared a project, which was approved, upon the following basis :—

1. To bring ordinary rainfall (except that of heavy rains), domestic water, and water from the roads and from the *vallons*, to an intercepting Sewer, and convey it to a place where it could be raised by pumping.

2. In times of heavy rain to ensure the outflow of the water by a sufficient number of storm overflows established on the south side of the intercepting Sewer.

The project proposed that the fosses should be abolished, and the fœcal matter removed by the Sewers.

An intercepting Sewer has been constructed along the Boulevard of La Croisette, crossing the streams of the Baume, the Gabres, the La Foux, and the Châtaigner, ending at the existing Sewer in the Rue d'Antibes. This Sewer traversed a length of 1,940 mètres. The fall is 0·001 m. per mètre. In this distance there are six storm overflows, viz., at the

Baume, the Gabres, the end of the Rue du Rond Point, Rue Rostan, Rue Macé, and Rue Bossu.

These overflows consist of openings constructed in the slope of the wall which protects the boulevard from the sea. The inverts of the overflows are at a height of 0·40 m. above the bottom of the invert of the Sewer. The openings are 0·75 mètre high, and 1 mètre wide.

The project assumes that the flow of sewage, exclusive of rainfall, in the intercepting Sewer of the Boulevard de la Croisette will not exceed 30 litres per second. With rain the water would rise in the Sewer to the height of 0·40 mètre above the invert; the Sewer would then remove 250 litres per second; a further rise would cause it to overflow through the overflow openings into the sea.

The storm overflows are each capable of discharging 1,000 litres per second when the level of the water in the Sewer rises to the springing of the arch.

The intercepting Sewer has been carried under La Foux by means of a syphon, which has a fall of 0·12 m.; the pipe of the syphon is 0·40 m. diameter, and it is calculated to convey 186 litres per second.

The Châtaigner is also carried across the Sewer. The invert of the Sewer is not altered, but the height of the Sewer is reduced by about two-thirds. Thus reduced it is calculated to convey 250 litres per second.

Secondary drains are designed to bring the water from the town area to the intercepting Sewer. The following are the secondary drains which have been constructed: a Sewer in the Rue d'Antibes, from the Passage à Niveau to the Rue des Roses; the Sewer in the Rue du Rond Point Duboys d'Angers; and a portion of the Sewer in the Rue Rostan from the Rue des Jardins to the Boulevard de la Croisette.

M. Bruniquel further proposes to lift the sewage by steam power, in order to convey it by a cast-iron pipe or a Sewer to the Plaine de Laval at the Trou de l'Ancre, and thence to discharge it into the sea.

The place suggested for raising the sewage, in the Engineer's Report, is near the Mole, on land belonging to the Administration.

The cost of this project is estimated as follows :—

	Francs.	
1. Égout collecteur de la Croisette	96,222·58	
2. Subsidiary Sewers	334,413·00	
3. Incidental Works.....	86,364·42	
		517,000
Pumping Stations and Outfall Sewers, &c. ...		168,000
		685,000

The cost of the works which have been executed would appear from the estimates to amount to under 150,000 francs, which leaves 535,000 francs still to be expended.

This project has been designed with great care and much ability.

2. *The District outside the Town.*—M. Bruniquel's plan does not affect the existing arrangements, by which the fouled water from the Villas and Hotels continues to flow into the *vallons.*

The Mayor has, however, initiated an important improvement in the *vallons* by cementing the bed of the *vallon* and forming in the centre a small trough in cement below the general level of the bottom in which the water flows in dry weather. This system has great merits; for where this arrangement is carried out it prevents the stagnation of the domestic water in the rough beds of the *vallons.* It further contemplates an arrangement for admitting this water into the *égout collecteur.* There is, however, this difficulty. In times of rain the flood-water comes down so rapidly that it brings with it stones, sand, &c., which remain in the small trough, and have to be removed by hand labour; and some of this material would certainly be occasionally carried into the *égout collecteur.*

The Mayor is further endeavouring to prevent the defiling of the surface of the ground by individuals by constructing at various spots public latrines. For these he has adopted a system of tinettes or metal barrels, holding about 50 litres each, which are removed by the Compagnie des Vidanges as soon as

full. These can be hermetically closed, and do not present the dangers of a fosse.

7. *Recommendations.*

It appears that the Administration are fully alive to the dangers to health which may arise from the existing fosses, seeing that they have adopted the plans of Messieurs Bruniquel and Vigan, who propose to abolish the fosses in the town; but it is to be feared that if fœcal matter be placed in Sewers constructed under the conditions proposed in the project, it might result in serious inconvenience.

A. *The Town.*—The first question which occurs is, to what extent is it desirable or necessary to provide for the removal of the rainfall in Sewers for fouled water?

The rainfall is not frequent at Cannes, and when the rain falls it generally falls in a large quantity in a short time.

In times of rain, and especially of heavy rain, water from the macadamised roads carries more or less mud, sand, or stones into the drains, which necessarily tend to cause deposit.

In dry weather the flow of water in the Sewer and the consequent velocity would be too small to carry away the deposit. Therefore, not only would a constant expense be required for cleansing the

Sewer, but if the fœcal matter were allowed to flow into drains subject to this liability to obstruction, it would be very likely to develop Sewer gases, from which danger to health might result.

The best way of preventing permanent deposits from taking place in drains or Sewers is to exclude, as far as possible, solid or other matter which is liable to cause deposit ; and to provide during a certain period daily for such a velocity in the Sewer as would remove any deposit which does occur. For removing road *detritus*, this velocity must certainly not be less than 0·75 mètre per second.

If the rainfall on streets be excluded from Sewers constructed to carry off the foul water, the sand and stones which are carried into Sewers by the heavy rains would be kept out, and this cause of deposit would be avoided. Moreover, the size of the Sewer might be more nearly adapted to the work it has ordinarily to perform, and a higher velocity be obtained, at least for a part of every day. Whereas, when a Sewer is merely adapted to the exceptional cases of a large rainfall, the sewage proper would afford only a small stream in the bottom of the drain during the dry weather.

It has been already explained that the site on which the town of Cannes and the occupied portion of the Commune stand is intersected by numerous

streams, and that the Commission which reported on the causes of the inundation of the 27th of October, 1882, recommended the construction of a new channel for storm-water across the town, parallel to La Foux. These streams afford a ready means of disposing of the rain-water, and in most cases by surface channels.

It is therefore proposed, as a general rule, to exclude surface water, including rain which falls on the streets and houses, from the drains, and to retain the drains chiefly for domestic water and fœcal matter.

Under this arrangement the dimensions of the drains for foul water in the town would vary from 0·15 m.=6 inches in diameter to 0·30 m.=12 inches in diameter. They would lead the sewage into the existing secondary drains and into the *égout collecteur*, by means of which it would pass to the Mole.

The rain which falls on back-yards and on stable-yards must pass into the drains; the rain which falls on roofs and paved streets, as it would not bring in matter liable to cause deposit, might be allowed, in exceptional cases, to pass to the drains; but, as a rule, the rainfall on streets, roads, and roofs would pass along surface channels either to the *ruisseaux*, or to existing drains, or direct to the sea.

In those parts of the town where the streets are

paved, and where large Sewers have been already made, the rainfall from the paved surfaces might continue to pass into them.

In exceptional cases, where it may be found advisable to allow some of the rain-water to pass into the drains from macadamised or gravelled surfaces, gullies should be constructed to intercept the grit.

The intercepting Sewer at the Boulevard de la Croisette has been constructed in a more oval form than the drawings show; but it is for consideration whether it might not be desirable, in order to obtain an increased depth with the dry-weather flow of sewage, to mould in concrete a trough in the bottom of that Sewer, and of the new Sewers in the Rue d'Antibes, the Rue du Rond Point, and the Rue Rostan, as well as in the older Sewer which extends under the Rue Centrale and the Quai St. Pierre to the Mole. A flushing-tank should be placed at the head of the Sewer, near the Propriété des Sablons, and another of larger size at the Rue d'Oustinoff.

At the point where the intercepting Sewer of the Croisette crosses the Châtaigner, the section of the Sewer is reduced, but the level of the invert is not altered. The Commission which reported on the inundation of the 27th of October, 1882, recommended that the bed of the Châtaigner be lowered at its

outlet into the sea to facilitate the outflow of flood waters. To allow of this being done, it would be necessary to carry the intercepting Sewer under the Châtaigner by means of a syphon. The diminution of fall in the portion of the Sewer between the Châtaigner and the Place des Iles which the construction of the syphon would entail, would have to be compensated for by increased means of flushing. It would also be advisable to provide special flushing arrangements for this syphon as well as for the syphon under La Foux.

The storm overflows in the intercepting Sewer of the Croisette should be retained, but their sides should be raised from 0·40 above the invert to 0·50, and the openings should be utilised for ventilation. It would also be necessary to make special arrangements in the upper part of the intercepting Sewer for conveying to the sea, across the Boulevard de la Croisette, the surface rainfall proposed to be excluded from the Sewers.

A tabular statement has been prepared of the sizes of the drains proposed to be constructed in the town, in the place of those specified in the plan drawn up by M. Vigan.

The inclination which could be given to these drains would enable them to remove the rainfall on roofs and paved yards, except in certain cases.

The general conditions to be observed in the construction of the drains are as follow :—

1. The inner surface of the drains should be smooth, and the joints should not present irregularities. Consequently, unless the drains are moulded in concrete, it would be desirable that English glazed stoneware pipes should be used, except where it might appear in special cases that cast-iron pipes were desirable.

2. The pipes should be laid on a sound bed; in soft ground either a concrete bed would be necessary, or iron pipes should be used.

3. The joints of stoneware pipes should be of cement, and be water-tight, so that the sewage should not escape from the drain into the subsoil. The iron pipes should have socket-joints turned and bored.

4. In order to prevent the cement from entering the drain-pipes whilst making the joint, it is desirable, after the pipes are placed in position, to force into the sockets a layer of tarred hemp before making the joint with cement: this will also serve to retain the centres of the pipes in true position.

5. A drain once completed ought never to be broken into. The only places by which it should be examined are at the manholes. Therefore, wherever it is probable that a connexion with a house-drain will be needed, a junction pipe should be laid; no junction

should be less than 0·15 m. = 6 inches in diameter; the opening into the junction should be temporarily closed with a plate and cement until needed. It would probably be desirable that in the case of drains which are laid in streets in which the houses have not yet been all built, the junctions should be placed at distances not exceeding from 6 to 10 mètres apart. The position of all such junctions should be carefully noted on the plans.

6. The drains should be laid in a direct line from point to point, both in plan and in gradient.

7. At points where one drain joins another, manholes should be constructed. In some cases these should be provided with flushing arrangements.

8. At every change of direction or of gradient there should be either a lamp-hole or a manhole to permit of the examination of the drain. These should also afford ventilation. There should not be more than one lamp-hole between two manholes, except on a straight and level line.

9. There should be ventilators at the head of every drain, and openings for ventilation should be provided once in every 50 mètres of the length of the drain.

Permanent ventilation of Sewers is absolutely necessary. When Sewers are unventilated, gas accumulates in them, and becomes deadly; whereas in ventilated Sewers the air may be comparatively pure.

10. At the head of every drain should be placed a flushing-chamber, which should be arranged so as to provide ventilation.

In flushing drains and Sewers, it may be assumed that the following volumes of water would suffice for each occasion of flushing; the time of discharge extending from one minute, in the case of the small drains, to five minutes, in the case of the larger Sewers:—

Diameter of Drain or Sewer.	Volume of Water in Flush Tank.
Mètres.	Litres.
0·10	80
0·15	200
0·22	450
0·30	750
0·38	1,200
0·45	1,650
0·50	2,000
1·00	8,000

The best flushing arrangement is Field's Automatic Flush Tank. A small current of water constantly trickling serves to fill it, and when full it discharges automatically with great rapidity.

11. On steep gradients arrangements might be necessary to arrest the rush of sewage down the gradient, and to prevent the upflow of sewer gas.

Drawings showing the general form of ventilators, lamp-holes, and flushing-chambers, applicable to these drains, are appended. (Plate No. 2.)

I estimate that the expense for the town drains would not exceed 150,000 francs. But it would be necessary to make a detailed study of the circumstances of each of the streets and roads, with reference to the depths of basements, and other conditions, in order to give an accurate estimate of the cost.

It may, however, be assumed that the cost of sewering the town on this basis would be materially less than the sum which would be required for completing the drainage included in the plan which has been commenced.

When these drains have been completed in any street, the houses should be required to connect with them for the removal of the refuse water. If the occupier of a house desires to use a drain for the removal of fœcal matter, he should be at liberty to do so, provided he abolishes the fosse, and passes the water-closet drainage direct to the drain. On no account should the overflow of a fosse be permitted to pass into a drain.

The arrangements for the connexion of house-drains with the Sewers should be supervised by the Administration, and no house should be allowed to connect with the Sewers unless the connexion be

made in a manner which is approved by the authorities.

There should not be a direct communication between the house-drain and the street Sewer. That is to say, there should be a ventilated opening on the drain; and the gases from the Sewer should be prevented from passing to this opening by means of a trap, placed between the opening and the Sewer. This is shown in the accompanying drawings.

The following are the principles which should be observed with respect to house-drainage:—

1. House-drains should be made either of glazed stoneware pipes with cement joints, or preferably of cast-iron pipes jointed with carefully-made lead joints, or with turned joints and bored sockets. They should be proved to be water-tight by plugging up the lower end of the drain-pipe, and filling it with water. In no case should a soil-pipe be built inside a wall. It should be so placed as to be always accessible.

2. The pipes should be generally 0·10 m.=4 inches diameter. In no instance need a drain-pipe inside a house exceed 0·15 m.=6 inches in diameter.

3. Every drain of a house or building should be laid with true gradients, in no case less than 0·01 per mètre (or $\frac{1}{100}$), but much steeper would be preferable. When from circumstances the drain is laid at a smaller inclination, a flush-tank should be pro-

vided. They should be laid in straight lines from point to point. At every change of direction there should be reserved a means of access to the drain.

4. No drain should be constructed so as to pass under a dwelling-house, except in particular cases when absolutely necessary. In such cases the pipe should be of cast-iron, and the length of drain laid under the house should be freely ventilated at each end, and a flush-tank should be placed at the upper end.

5. Every drain should be arranged so as to be flushed, and kept at all times free from deposit.

6. Every house-drain should be ventilated by at least two suitable openings, one at each end, so as to afford a current of air through the drain, and no pipe or opening should be used for ventilation unless the same be carried upwards without angles or horizontal lengths, and with tight joints. The size of such pipes or openings should be fully equal to that of the drain-pipe ventilated.

7. The upper extremities of ventilating-pipes should be at a distance from any windows or openings, so that there will be no danger of the escape of the foul air into the interior of the house from such pipes.

8. The soil-pipes from all water-closets, and waste-pipes from slop-sinks for urine, should be continued above the eaves of the house, for ventilation, and

there terminate, with the ends open to the air; and if such ends be at or near any window of the house, it would be necessary to further continue such pipes to the ridge of the roof. Every such continuation should be of the full size of such soil or waste pipes. The soil-pipe should terminate at its lower end in a properly-ventilated disconnecting trap, so that a current of air would be constantly maintained through the pipe.

9. No rainwater-pipe and no overflow or waste-pipe from any cistern or rainwater-tank, or from any sink (other than a slop-sink for urine), or from any bath or lavatory, should pass directly to the soil-pipe; but every such pipe should be disconnected therefrom, by passing through the wall to the outside of the house, and discharging with an end open to the air.

Drawings are appended of different forms of intercepting-traps which may be placed between the house drains and the public Sewers. (Plate No. 1.)

B. *The District outside the Town.*—The rainfall on and around the Villas and Hotels would continue to pass to the natural outfalls, and need not be considered in the construction of the drains for foul water. On the Route de Grasse, and at the new Boulevard, special arrangements might, however, be required.

The Villas and Hotels are, in many cases, so

situated that it would be difficult to drain them, except into the *vallons;* it is therefore necessary that drains be laid in the *vallons*, with which the houses on each side should be required to connect.

In those cases where the roads afford the easiest and most convenient method of affording drainage to the Villas and Hotels, drains should be laid along the roads.

A table has been prepared, showing generally the length of drains in the *vallons*, with supplementary drains along roads, which it appears necessary to provide for these districts. This statement is necessarily only approximate. A special study of the levels and other circumstances connected with the roads and houses must be made before an accurate statement could be given.

The drains in the *vallons* should be cast-iron pipes. The pipes would be socket-pipes, with the ends turned and bored for the joints. They would be in lengths of 9 feet. The pipes of 0·22 mètre and 0·30 mètre diameter would be 0·0125 mètre thick; the pipes of 0·40 mètre diameter would be 0·018 mètre thick.

The strength of these pipes would enable them to be laid nearer the surface than pipes of stoneware, and a smaller diameter would be admissible with iron than with stoneware pipes, as they would discharge under pressure without risk.

It would be necessary to provide a ventilator and a flushing-chamber at the highest point of each of these drains.

The conditions under which these pipes would be laid, with regard to ventilation and to changes in direction and gradient, and to the connexions with the drains from houses, Villas, and Hotels, would be similar to those already mentioned.

To enable connexions to be made with houses on the line of pipe, junctions should be cast upon a certain proportion of these pipes; this proportion can only be determined after a study of the circumstances of each *vallon*.

It would be necessary to provide a ventilated manhole at every change of direction of the pipes in the *vallons;* it might, therefore, be convenient in many cases to make junctions with the drains, from the neighbouring Hotels and Villas, at these openings.

These drains from the *vallons* would be continued along the bed of the *ruisseaux* to join the existing *égout collecteur* in the town; but they should not be connected otherwise with the town drains.

From a superficial estimate, it may, I think, be safely assumed that 350,000 francs would provide for this drainage.

C. *Regulations for Connexions with House Drains.* —When these drains have been laid, every Villa, house, or Hotel, within a distance of 200 mètres,

should be required to provide for passing the fouled water into the drain. If the occupier of a Villa or Hotel desires to send away by the drain the fœcal matter, he should be allowed to do so on condition of abolishing the fosse and sending the water-closet drainage direct to the drain.

No overflow from a fosse should, under any circumstances, be passed into these drains.

If the proprietors or occupiers of Villas or Hotels prefer to retain the fosse, they must not have any overflow from it; and it should be a regulation that the proprietor or occupier be required to cause the fosse to be emptied and thoroughly well cleaned once in every three months. The matter thus removed from the fosse must on no account be allowed to pass into the drain.

D. *Limits of the Project of Drainage.*—This would bring to the *égout collecteur*, and to the existing outfall, the drainage between the Ruisseau de la Baume and the Ruisseau du Riou. It would not include any arrangements for Cannet, where, if the buildings increase, a large amount of drainage will have to be provided for. The plan leaves untouched the drainage now passing into Golfe Juan and of the Promontory of the Croisette, as this drainage need not be brought through the *égout collecteur*, but might be dealt with separately.

Between the Riou and the Château de la Bocca,

where the Plaine de Laval commences, the houses consist almost entirely of Villas and Hotels, which are cut off from the shore by the railway.

The amount of water which is furnished by the Canal de la Siagne to this part of Cannes is 1,975 cubic mètres.

The fouled water from these Villas and Hotels would be brought by this plan down the several *vallons* to the sea-shore.

If it be decided to construct the outfall at a point near the Trou de l'Ancre, the sewage from the more important of these Villas could probably be placed in the outfall-drain, without lifting it.

As a temporary measure, and until the proposed new outfall Sewer has been constructed, it would be desirable to carry the ends of the iron pipes from these *vallons* into the sea sufficiently far to deliver under water.

The system I have thus sketched out would remove the evils arising from the retention of the foul water and the fœcal matter in and around the dwellings.

E. *Public Latrines.*—The Mayor of Cannes has initiated a system of public latrines to avoid the extensive defilement of the surface which now takes place.

If the system of water-carriage for fœcal matter be adopted, that system should be utilised for the public latrines.

The system of latrines devised by Bowes Scott & Read, with Field's automatic flush-tank, appears to be especially applicable to this purpose.

This form of public latrine would not be more expensive than the form now adopted in first construction. It would be easier and cheaper to keep clean, and would be comparatively free from smell.

F. *The Outfall at the Trou de l'Ancre.*—The place proposed for the outfall by M. Bruniquel is a spot called the *Trou de l'Ancre* in the Golfe de Napoul, about 4,600 mètres from the Mole of Cannes, and about 1,700 mètres from the Verrerie. It is about 1,500 mètres east of the mouth of the Siagne.

The current of the Siagne is strong, and the fresh water from it is perceived on the surface to a distance of at least 2 kilomètres from the shore. It would thus undoubtedly prevent the deposition of any sewage on the shore of the bay near Napoul. The railway runs very near the shore of the bay, between Cannes and the proposed outfall; consequently, no houses could be built near the outfall.

There are no currents in the bay other than that due to the river Siagne, and currents due to the wind. The shore is of sand, and shallow near the shore. It deepens considerably at about 100 mètres from the shore, and the centre of the bay is very deep.

The selected position would offer every probability of relieving the town of Cannes of any apprehension of suffering from the reflux of the sewage along the beach of the inhabited portion of Cannes.

The outfall, however, presents some inconveniences.

The river Siagne has apparently changed its bed to one further west. The old bed of the Siagne, in which water still flows, is a stream named the Béal, of about 20 feet wide by 3 feet deep. It approaches the shore at a distance of about 400 mètres beyond the point selected for the outfall, and runs parallel to the coast for about 1,500 mètres, till it falls into the river Siagne, being separated from the sea by dunes of sand. It is probable that the shore is gradually gaining on the sea at this part of the coast.

To avoid the liability of the outlet being choked with sand, which this conformation of coast presents, some special arrangements would probably be necessary.

M. Bruniquel proposed one of two plans for the sewer to reach this outfall.

1. To elevate the sewage from some point in the town to a reservoir at the ancient cemetery, a height of 30 mètres above the sea, and to run it thence through an iron pipe carried as far as neces-

sary along the Route Nationale, N. 97, and thence across to the sea.

2. To elevate the sewage at a point near the Mole, and allow it to flow thence to the outlet.

The observations which occur upon these proposals are that a reservoir of sewage is not a thing which any one would desire to construct if it could be avoided; but in the absence of a reservoir there would be a necessity for continual pumping day and night, unless the flow during the night were allowed to pass direct into the sea. It would be necessary to retain the outlet behind the Mole, in case of accident to the outfall Sewer. And inasmuch as the night flow of sewage would be small, and probably much diluted with water, it is not probable that inconvenience would result from allowing the Sewer to discharge at this point during the night, especially as at this place the discharge would be into deep water, at the back of the Mole, outside the harbour, and removed from the shore.

The outlet at this point should, however, be remodelled, and be terminated in an iron pipe firmly fixed to the rocks, and turned down, so that the mouth will at all times deliver downwards vertically under water, and thus prevent the possibility of sand and gravel accumulating in the drain.

SUMMARY.

The recommendations which I have made are based upon the inexpediency, as regards health, of retaining any matter liable to putrefy in and around the houses.

These recommendations are briefly as follow:—

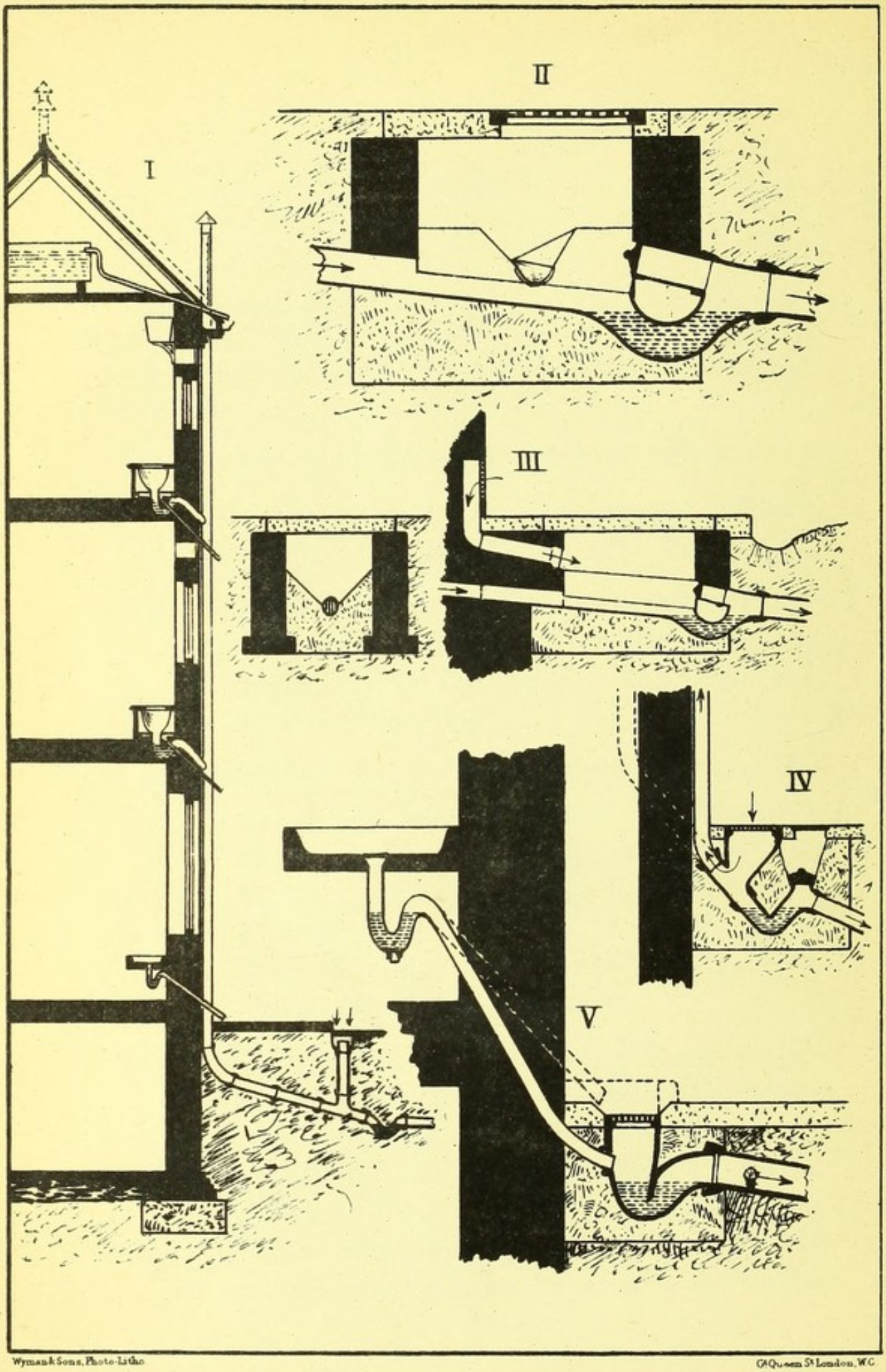
1. To abolish all permanent receptacles of fœcal matter in, beneath, and near the houses.

2. To remove, by means of properly-constructed Sewers and drains, all water which is rendered foul by domestic use, including the fœcal matter.

3. To exclude from these Sewers and drains the rain which falls on streets and roads, so as to enable the dimensions of the drains to be reduced, and also to prevent the obstructions in the drains, which occur from sand and stones which storm-water brings from a large surface.

4. To place the regulation of private drains under the control of the Administration; and to insist upon house-drains being ventilated, and upon a disconnecting-trap of approved construction, with proper ventilation, being placed on every private drain between the house and the public

Nº 1.



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Sewer, so as to prevent the passage of sewer-gas from the Sewer to the house.

5. To flush the public Sewers regularly at fixed periods; and to see that private drains are kept in good order and flushed at intervals.

6. To extend the Service de Balayage, and to remove all dry refuse from houses, at least once, if not twice, in every week.

7. To make arrangements for conveying this refuse matter out of the town to a properly-arranged depôt, and all refuse which cannot be converted to use to be burned in a specially-constructed kiln.

It cannot be expected that the suggested changes can all be made at once.

When the Sewers which I have indicated have been constructed, many proprietors will be ready to make use of them. But all persons desiring to use them for fœcal matter must be strictly forbidden to place the overflow from a fosse in a Sewer. The fosse must be abolished as a preliminary to using the Sewer, because the putrefying overflow from a fosse must on no account be allowed to enter the Sewer.

Although the question was not included in the reference made to me, it is necessary to call attention to the Canal de la Siagne. The Canal is an open aqueduct, not fenced in; the district through which it passes must become more frequented, year

by year, as the population of Cannes increases, and the risk of pollution of the water must become greater. Therefore, in order to guard against the dangers which would be caused by the contamination of the water-supply, it is essential that the Canal should be fenced in or covered over.

If the principles laid down in this Report be carried out in the manner indicated, if the cess-pits be all abolished, if the drains in each house be connected with the Sewerage through a disconnecting-trap, and if adequate arrangements be made for the removal of the dry refuse, I venture to think that the sanitary arrangements at Cannes will leave little to be desired.

I would add that although the expense of the proposals which I have made, including the outfall Sewer, will somewhat exceed that of the plan already approved, yet it will be a material economy to the community, as the large sums which individual proprietors have now to pay for emptying their fosses will be saved.

DOUGLAS GALTON.

12, Chester Street, Grosvenor Place,
London, *February*, 1883.

EXPLANATION OF DRAWING No. I.

FIG. I. Arrangement of Soil-pipes and Waste-water Pipes in a house.

FIG. II. Ventilated Intercepting-trap between the house-drain and the Sewer, suitable for an open space, and for one, two, or three houses.

FIG. III. Ventilated Intercepting-trap between the house-drain and the Sewer, suitable for a street or under a foot-path, and for one or two houses.

FIG. IV. Hellyer's Ventilated Intercepting-trap.

FIG. V. Waste-pipe of Kitchen Sink, delivering in the open air.

EXPLANATION OF DRAWING No. II.

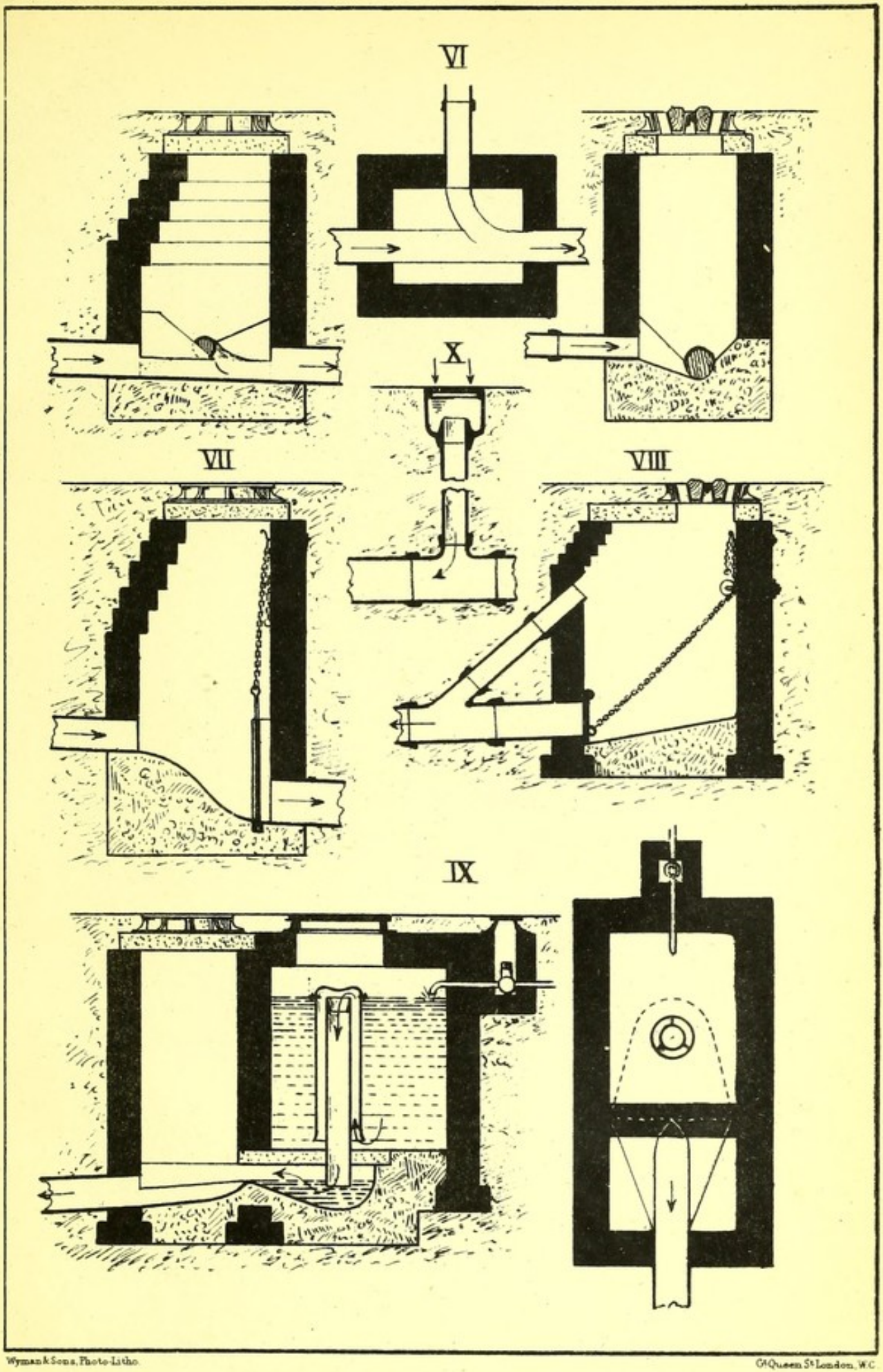
FIG. VI. Ventilated Manhole at junction of two Sewers.

FIG. VII. Ventilated Manhole and Flushing-chamber on steep incline.

FIG. VIII. Ventilated Manhole and Flushing-chamber at head of a Sewer.

FIG. IX. Field's Automatic Flushing-chamber, with ventilation.

FIG. X. Ventilator and Lamphole.



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