Mr. Chadwick's reports on the sanitary condition of Hong Kong ; with appendices and plans / [O. Chadwick].

Eastern,
No. 38.

Printed for the use of the Colonial Office.

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SANITARY CONDITION OF HONG KONG;

WITH

APPENDICES AND PLANS.

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SANITATION OF HONG KONG.

MR. CHADWICK'S REPORT.

To the Crown Agents for the Colonies.

Park Cottage, East Sheen, Mortlake,
18th July 1882.

Gentlemen,

I have the honour to submit herewith, for transmission to the Right Honorable the Secretary of State for the Colonies, the following Report on the Sanitary Condition of Hong Kong, together with suggestions for the improvement of such defects as in my opinion exist.

Method of inspection.

On my arrival in Hong Kong, I inspected the various quarters of the town, the waterworks, and examined the sewers. I endeavoured to form a correct idea of the average condition of the dwellings of the working classes, and to avoid concentrating my attention on extremely objectionable instances. The houses which I describe were selected on this principle.

The opinion of the Chinese ascertained.

Having formed a general opinion of the defects of the existing state of things, and of the measures necessary to remedy them, I proceeded to ascertain the feelings of the Chinese population, and to elicit information as to their domestic institutions, so that the measures proposed might be suited to them, and have as far as possible as a basis, time-honoured custom.

Question-papers sent to Chinese as the simplest means of opening discussion.

As the subject was new to those whom I proposed to consult, it seemed well to place it before them in some definite form, so as to limit the discussion to the points at issue. I was advised also that the Chinese were well accustomed to express their views in writing. I therefore drew up a series of questions which embodied the crude ideas which I had formed, and submitted them to certain bodies, both collectively and individually.

Returned with answers.

These question papers, of which to the number of nearly two hundred, were returned to me with replies, in some cases with remarks of considerable length, showing much enlightened thought and care.

Interest shown by Chinese in subject.

On the whole I was most agreeably surprised to find that the subject received most intelligent attention, that its importance was recognised, and that there was no obstruction or apathy.

The various bodies to whom questions were sent.

The bodies to whom I sent the papers were the "Tung-Wa" Hospital Committee, the two Associations of Chinese Medical Practitioners, and the Roman Catholics, the Chinese and the Hakkar Christian Churches. The Tung-Wa Committee obviously represents the moneyed and house-owning interests; to ascertain the feelings of the tenants the medical associations were included, the members of which, though educated, are not wealthy.

To penetrate still deeper into the mass of the people, I could think of no better means than to consult the Christian churches, the members of the two last named certainly differ but little from the rest of their countrymen, except in religion. They have been "Christianised" but not "Westernised."

Canton visited.

I also visited Canton, where I had the benefit of the experience of Dr. Kerr in ascertaining the state of habits there.

Meeting at Tung-Wa Hospital.

Having received the answers to my questions in detail, I attended a meeting at the Tung-Wa Hospital, there being present the Committee of the Hospital, members of the Medical Corporations, and some others who took interest in the subject. With the able assistance of the Hon. Ng-Choi, Mr. Y. Ayuk, and Mr. Ho Amei as interpreters, the questions were explained and the sense of the meeting obtained generally. A similar meeting of the members of the Hakkar and Chinese Protestant Churches was also held.

Suggestions of Chinese considered in suggestions.

Having thus obtained some knowledge of the sanitary habits and institutions of the people for whose benefit the measures are principally intended, I trust that my suggestions will prove satisfactory and practicable.

Special attention directed to obviate certain difficulties.

The principal objections raised, were due to fear of increased taxation, and to a dread of tyrannical interference by public officials, of "squeeze," in short. In framing suggestions I have given special attention to the best means of avoiding these evils.

Division of report into descriptive and suggestive matter.

The main report is divided into two parts, the first descriptive of the state of things as I found them, the second discusses the defects and suggests remedial measures. The villages are treated in a third part. This arrangement perhaps involves some repetition, but it seemed well to distinguish clearly fact from opinion.

Abstract desirable on account of length of report.

As the report is necessarily long, I will give a brief abstract of its contents and of the opinions therein expressed.

The question of surroundings of barracks treated separately.

The special question relative to the surroundings of the barracks is discussed in a separate report.

Bad sanitary condition of Hong Kong. Mortality and vitality. Paras. 111, 123.

The sanitary condition of Hong Kong is defective, and calls for energetic remedial measures. The death-rate is high, whilst the average age at death is low.

Requirements of sanitation. Paras. 124–136.

Complete sanitation demands the immediate and complete removal of all organic refuse. The dry-earth system facilitates the removal of human excreta, and abates nuisance in so doing. It does not effect the removal of the remaining and far larger amount of refuse for which purpose drains are required. It does *not* do away with the necessity for proper drainage, owing to difficulty of obtaining proper earth; it is inapplicable to Hong Kong.

Dry earth system, its objects and effects, Paras. 140–143.

Existing water supply inadequate. Necessity for measures to prevent waste even with increased supply. Paras. 74–84 and 219–239.

Nature of measures. Paras. 220, 221.

Scale of charges. Paras. 229, 230.

The present water supply is inadequate, but this is about to be remedied. Unless waste of water be prevented, neither the proposed works, nor works many times larger, would satisfy the wants of the city. To provide powers for prevention of waste a new Waterworks Ordinance is required, also to provide a new scale of charges of water. The present water rate is unequal and unjust in its incidence.

Improvement of present intermittent supply. Paras. 222, 231–236.

To improve the present intermittent supply and render the distribution more uniform and effective, it would be desirable to lay down certain new water mains. These will also be required for the distribution of the augmented supply when the new works are finished.

Unsanitary state of dwellings. Paras. 24–61, 146–193. Amended building law required.

Both the design and construction of existing dwellings is defective—the Building Ordinance requires complete revision. The amended law must be enforced with more rigour and intelligence than at present, particularly as to alleys, lanes, and open spaces.

House drainage urgently required. Paras. 41–46, 184–191.

The system of house drainage is radically bad. The whole of the dwellings within the town require re-draining, and unless this is done but little health-improvement will be made.

Method of executing distribution of charges. Paras. 180–181.

The complete cheap and proper execution of this work can only be effected by the Government undertaking it. The cost of the work will be considerable, even if carried out with the greatest economy. It is unjust to compel a landlord to pay a lump sum for remedying defects which have virtually received official sanction. The payment for these improvements should be distributed over several years. As the general public and the tenants are the principal beneficiaries by the expenditure for house improvement, it will be just and expedient for the Government to pay for their execution out of general revenue.

Construction of intercepting sewer. Paras. 181, 197–205.

Determination of outfall. Paras. 200–201.

The constructing of an intercepting sewer to divert the sewage from the harbour is desirable. The benefits to health derived from this work alone will be small compared to that derivable from improvement of house drains and sewers. The determination of the best outfall is the first step to be taken. This requires the investigation of the tidal currents at different seasons of the year.

Improvement to existing sewers to render them suitable for sewage. Paras. 203, 204, 207–208.

The present sewers may by minor improvements be made suitable for the conveyance of sewage as well as storm-water. The sewage only should be diverted from them to the intercepting sewer by which it is conducted to a distant outfall; storm-water must go direct to the harbour.

Scavenging and night-soil removal. Paras. 240–273.

Dry-earth system unsuitable. Paras. 241–246.

Proposed reforms of existing system. Paras. 249–273.

As to scavenging and night-soil removal. To encourage the introduction of excreta into existing drains would be fatal. For the present at least some system of hand removal must continue. The dry-earth system is inapplicable on account of the difficulty of obtaining a supply of suitable earth, and the magnitude of the operations involved. Hence the present bucket system must continue in an improved form. To this end the night-soil removal contract should be separated from that of street sweeping. The night-soil contractors should have the complete monopoly of that substance for which they would pay a large sum on account of its value; they would see that complete collection took place. In the end a system of water carriage will certainly prove most

satisfactory; when all is ready for its gradual introduction. The proposed house drains are suitable for this purpose also.

Public latrines to be acquired. Paras. 88–91, 173–178, 261, 262, 266.

Public latrines are most valuable means of sanitation. They should be acquired by Government, improved, their number increased, and they should be thrown open to the public gratis. In towns having narrow streets, complete scavenging is of the highest importance.

This work, when separated from that of night-soil removal, can be more completely carried out and supervised.

An organised sanitary staff required. Paras. 274–286.

For the proper supervision of all these works, to introduce habits of cleanliness, to detect and remedy evils, an organised sanitary staff is required, operating under the personal direction of a responsible European officer. That either the Colonial Surgeon or the Surveyor General should be required to exercise the necessary personal supervision, is incompatible with their other duties.

Appointment of sanitary officer recommended. Paras. 280–281.

The appointment of a special officer is recommended, personally to supervise the sanitary staff, the Surveyor General and the Colonial Surgeon and administrative retaining their consultative functions. The Surveyor General's department will continue to execute new works and repairs.

Employment of district watchmen in enforcing cleanliness. Paras. 282.

To reinforce the sanitary staff, and to make the work of inspection more palpable to the Chinese, it is proposed to add the duty of enforcing cleanliness to the present duties of the district watchmen, increasing, if necessary, their number and pay.

Sanitary Officer to be placed in office of Registrar General. Paras. 283, 284.

To bring the Sanitary Officer directly in relation with the district watchmen, it is suggested that he should be, to some extent, a member of the office of the Registrar General or Protector of Chinese, who now directs the district watchmen in their duty of maintaining order. The Registrar General is, and always must be, an officer speaking Chinese, whereby it is hoped that many minor difficulties will be smoothed over. The district watchmen being nominated by the community, and approved by Government, will tend to this result also, by giving the public some voice in the matter. The Sanitary Officer will receive technical instructions from the Surveyor General and Colonial Surgeon respectively, and refer, through the Registrar General, any technical difficulties to them for their opinions.

Condition of markets. Paras. 275.
Want of baths and washhouses. Paras. 272–273.

I would call attention to the indifferent condition of the markets, and the want of baths for the poor, also public laundries. The second want was pointed out to me by the Tung-Wa Committee. The provision of a proper water supply for Kowloon Peninsula is recommended, also for some of the larger villages.

Conclusion.

I beg to record my thanks to his Excellency the Governor and the official staff for the great courtesy shown to me, and for the great facilities afforded me in the execution of my duty.

I trust that even should these suggestions be found undesirable or impracticable, my report will show the necessity for strong and complete measures of sanitation, and I trust that they will be undertaken for the immediate benefit of the public health, without waiting for the necessity to be demonstrated by the irresistible logic of a severe epidemic.

I have, &c.

(Signed) OSBERT CHADWICK,
Associate Member Inst. C.E.


SLAUCHTER HOUSE OR BELCHERS POINT
DISTRICT No 1. SHEKTO
PRAYA
TO BE RECLAIMED
SLAUCHTER HOUSE
GAS WORKS
PRAYA
DISTRICT No 4
THEATRE
MARKET
DISTRICT No 3 TAIPINGSHAN
CLEVERLEY TANK
ROBINSON ROAD
CIT
1000

REPORT

ON THE

SANITARY CONDITION OF HONG KONG.

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PART I.

SECTION 1.

GENERAL DESCRIPTION.

Site of city.

1. The city of Victoria stands partly on the steep northern slopes of the mountain mass which forms the Island of Hong Kong, and partly on a narrow and comparatively flat strip of land which fringes their base. The lower portion lies principally between the Queen's Road and the Praya or wharf, which forms the harbour frontage of the town, and it is composed almost entirely of made ground.

Geological formation.

2. Excepting this limited amount of artificial ground, the soil on which the city is built is derived from the decomposition of granite or other primitive rock. It is not, however, formed of detritus of rock washed down from above, but of the solid rock altered "in situ." The constituent minerals remain in their original relative positions, but some of them, principally the felspar, have decomposed, and the whole mass becomes porous and friable, consisting of quartz crystals, embedded in a mealy clay, the product of decomposition of felspar, to which a red or yellow tint is given by the iron oxyde, liberated by the decomposition of hornblende and other analogous minerals. Embedded in this friable mass are large blocks of solid granite, which have hitherto resisted the decomposing agencies, whatever they may be. They are surrounded by a crust of rock in an intermediate stage of decomposition.

Evidence that decomposition has taken place "in situ."

3. The beds, joints, and veins of the original rock may be distinctly traced, running from the solid rock to the altered formation which surrounds it. Hence it is evident that the change has taken place "in situ."

Permeable nature of soil, infiltration of rain water. surface wells.

4. The ground formed by this process of decomposition is porous and the rain water from the upper slopes of the hills permeates slowly, but freely, through the whole mass on its way to the sea, appearing in the form of springs in the ravines where they intersect the water table. Numerous shallow wells show that this is at no great depth below the surface, especially in the lower parts of the town. Probably the water of these wells is naturally pure, but it is but too often contaminated by infiltration of filth from the surrounding habitations.

Influence of subsoil water on malaria.

5. It is possible that the existence of a large amount of subsoil water at no great depth below the surface, may have something to do with the development of malarious fevers, which, according to universal popular repute, invariably prevail whenever the surface is disturbed by excavation.

Outline of foreshore of city.

6. The general outline of the shore is a flattish **S** curve forming a bay, on the eastern side, a slight promontory to the westward. In front of the eastern part the water is shallow, and a considerable extent of foreshore is exposed even at neap tides. Towards the west deep water approaches the shore, and the Praya, or wharf wall, is in some places founded at or below low-water mark spring tides.

Tidal currents.

7. For more than 150 yards from the shore the tidal current is at all times, and in all places, very sluggish. In general terms it may be stated that the flood stream runs to the westward, the ebb to the east, but the current does not change exactly at high and low water.

Laws of tides.

8. The laws of the local tides have not been sufficiently investigated as yet. From observations recently made, it would appear that they resemble those of the tides of Bombay and the Indian Ocean, rather than those of the British Isles; the difference between neaps and springs being greater, and there being a great difference in the heights of alternate tides; a large tide in the morning being followed by a much smaller evening tide, or vice versâ, according to the season. Indeed the second tide sometimes disappears altogether, being merely represented by a diminution in the rate of rise or fall which may last for nearly 18 hours. The information collected concerning this matter, which has an important bearing on the selection of an outfall for sewers, will be found in the Appendix.

General description of site of city.

9. The city of Victoria extends along the shore for a distance of about $3\frac{3}{4}$ miles running back inland for about half a mile. Viewed from the opposite shore of the Kowloon peninsula, on the extreme left or eastern extremity, a projecting promontory of reclaimed land would be seen, occupied by sugar works. To the westward of this the Wong-na-Chong valley enters the sea. At its mouth is one of the largest pieces of flat land in the island, which is occupied inland, by the racecourse, and harbourward by building lots, at present but partially built upon. Westward of this again, the foot of the hills re-approaches the shore. For a distance of about three quarters of a mile, or up to $1\frac{1}{2}$ miles from the eastern extremity, the harbour front is occupied by warehouses, with a few second-class Chinese dwellings. At this point the naval and military establishments commence, occupying about half a mile of the water frontage, the barracks being on the slopes of the hills in rear.

Next to this is the City Hall, behind which are the public gardens. For about half a mile westward of the City Hall, the water front is occupied by the stores and offices of the principal European mercantile houses. Behind this the town climbs the side of the hill, terrace above terrace, to a height of 400 feet and more. Here are the majority of European dwellings and the Chinese houses of the better class.

A further length of half a mile is occupied, in front, by the principal Chinese warehouses, in rear is the densely packed Chinese quarter. This portion of about one mile west of the City Hall may be said to be the heart of the town. In front of it are anchored seagoing and river steamers of all sizes, sailing vessels and junks, whilst inshore, alongside the wharf, is a dense mass of boats and barges. The Praya here presents a scene of the greatest activity. To the west of this, again, the movement rapidly diminishes. Towards the western extremity, Slaughter-house or Belchers Point, Chinese warehouses line the shore, behind are dwellings, chiefly Chinese, but the whole has the appearance of a district but partially developed.

Slaughter-house Point may, for the present, be considered as the western extremity of the city. Beyond this is Belchers Bay, or Lap-sap-wan ("Rubbish Bay"); works of reclamation are actually in hand.

Arrangement of streets; absence of wheeled vehicles.

10. The streets running up the slopes of the hill, at right angles to the shore line, are far too steep for wheeled vehicles. In some cases indeed they are formed into steps; carriages drawn by horses are virtually unused. For passenger traffic a large number of "Jinrickshaws," small carriages drawn by men, have been recently introduced, and ply for hire in the Queen's Road and Praya. Chairs carried by coolies are still, however, the usual means of locomotion. Burdens of all sizes and weights are carried by men.

Population of Victoria.

11. The accompanying table derived from the census returns of 1881, gives an abstract of the statistics of the city of Victoria. The village and rural population is *not* included. Asiatics are notably unwilling to give any return of their true numbers, and therefore it is impossible to say how far these figures are to be relied on. They are certainly under, not over, the true numbers.

TABLE I.—STATISTICS of the CITY of VICTORIA, from CENSUS of 3rd April 1881.

—	Resident Population.				Temporary Population—Naval and Military Establishments, Police, Crews of Shipping, Prisoners.				Chinese Boat Population.	TOTALS.
	Europeans and Americans.	Goa, Indian, and Mixed Blood.	Chinese.	TOTAL.	Europeans and Americans.	Goa, Indian, and Mixed Blood.	Chinese.	TOTAL.		
Men - - -	935	426	66,928	68,289	4,564	735	2,527	7,826	7,635	83,750
Women - -	768	174	18,003	18,945	131	7	64	202	3,440	22,587
Boys - - -	699	185	8,774	9,658	158	6	98	262	3,061	12,981
Girls - - -	638	183	8,680	9,501	97	6	21	124	2,551	12,176
Totals -	3,040	968	102,385	—	4,950	754	2,710	—	—	—
Grand Totals -	—	—	—	106,393	—	—	—	8,414	16,687	131,494

Number of houses tenanted - - - - 6,402

Number of inhabitants per house, $\frac{106,393}{6,402}$ - - 16·6

Number of Chinese families - - - - 9,724

Total Europeans and Americans - - - 7,990

„ Indian, Goa, and Mixed - - - 1,722

„ Chinese - - - - - 121,782

Total population - - - - 131,494

Chinese deaths in 1880 recorded in Victoria - - 3,358

Chinese death-rate on census of April 1881 = $\frac{3,358}{122}$ mille. - - 27·52 per mille.

12. The Chinese form by far the majority of the population, and of them the men greatly preponderate, being more than three times more numerous than the women. Hence this large section of the community is not normally constituted. A very large proportion consists of working men, temporarily residing in Hong Kong for purposes of industry and trade. This is clearly shown by the very small number of Chinese families; 9,724 families to 68,000 men and 19,000 women.

Majority of population Chinese, small proportion of women, shifting nature of population, non-residence of families.

13. Like the Europeans, few of the Chinese are permanent settlers, but only temporary residents, coming to Hong Kong to avail themselves of the facilities offered by British rule, for earning money, with which they propose to return to their own country, to end their days amongst their own people. Even the richer Chinese, who possess much house property in the Colony, do not, as a rule, settle there with their whole family. Their first or principal wife remains at the home of their ancestors, in their native country.

Population chiefly non-resident.

14. The small number of really permanent Chinese settlers is due, to some extent, to the want of suitable sites on which they could build houses and plant gardens such as they like. It would appear, however, that even in their own country, the Chinese prefer to have their permanent dwelling in some country village, the home of their ancestors, rather than in great cities. Even in Canton, a considerable number out of the vast population of that city are only temporary residents, their wives and families residing elsewhere, in their native villages. This strong attachment to the native place is probably due to the joint family tenure of land which obtains throughout China. Real property does not descend to one heir, but is administered by the senior member for the benefit of the whole family.

Reasons why Chinese do not permanently settle. Tenure of land in China.

15. From 1872 to 1876 the population increased at the rate of about $2\frac{3}{4}$ per cent. per annum; from 1876 to 1881 the increase was at the rate of 3 per cent. Seeing that the proportion of women is so small, this increase cannot be due to births, but must be caused almost wholly by immigration.

Rate of increase of population due to immigration.

16. The Chinese population of Hong Kong comprises representatives of several distinct races or tribes, respectively different in appearance, habits, and speech. The written language is practically the same, but in speaking, the pronunciation and even construction varies so much, that one tribe cannot understand the other.

Races of Chinese represented in Hong Kong.

The following are the three principal tribes:—

(1.) The *Pun-tees* or Cantonese merchants, shop keepers, and artisans.

(2.) The *Hok-lo*, from Amoy and Foochow. These men are chair-coolies, boatmen, &c.

(3.) The *Hakkars*, from the north-east of the province of Canton. They are stone-cutters, barbers, smiths, and labourers. They bring with them many women, who shun the sight of foreigners less, and appear in public more than those of other races. They inhabit principally the district near West Point. It is most important that all these peculiarities be remembered when comparing the vital statistics of Hong Kong with those of other places.

17. The city of Victoria, with upwards of 130,000 inhabitants out of the total 160,000, is virtually Hong Kong. A few small patches of garden cultivation in the

Absence of any considerable agricultural population.

valleys are the only agriculture. The bare slopes of the hills afford pasture to a few goats and cattle. With these exceptions the island is uncultivated, and judging from the soil, and from the state of the adjacent and similar country on the main land, it does not appear likely to come under cultivation, to any great extent.

Remarks on sanitation apply equally to city and village.

18. Most of what may be said as to the sanitation of Victoria, applies equally to the villages, only in them the task is simpler, for they are less crowded, and the proximity of cultivation, facilitates the proper disposal of sewage.

Village population largely maritime.

19. The larger villages owe their existence either to European dock establishments, or to the large fleet of fishing and trading junks which resort to the bays on which they are situated, for shelter, or to refit and victual.

The Kow-loon peninsula.

20. The Kow-loon peninsula, however, merits special consideration; the irregular and broken nature of the soil, forbids it to be called a first-rate building site, except comparatively to the still more rugged slopes of Hong Kong. Nevertheless, in the absence of any large extent of better ground, it affords space for future extensions as a suburb, and room for manufacturing and commercial establishments.

Topographical and geological formation of Kow-loon peninsula.

21. The peninsula consists of a mass of low but steep hills, tumbled together in so irregular a manner as to baffle description. Between the hills are narrow flat valley soles, but little above sea level. The geological formation is the decomposed granite which is here seen in the greatest perfection. In some places large masses of sound granite exists, which are quarried, and afford an excellent building stone.

22. No stream of importance enters British territory from the mountains on the mainland.

Streams, wells, and irrigation of Kow-loon peninsula.

The rain falling on the peninsula, percolating through the porous soil appears in the form of rivulets in the valleys, in which wells of no great depth, give a good supply of pure water. The valleys are under cultivation with rice and vegetables, and are irrigated from the said streams.

Sanitation of villages considered separately.

23. To avoid complication the villages will be described, and their sanitary wants discussed, in a separate part, after the state of the more important city has been dealt with.

PART I.

Section 2.

Construction and Arrangement of Dwellings, House Drains, &c.

House sites artificially prepared on account of steepness of slopes.

24. On account of the slope of the ground on which the city of Victoria is built, most of the houses stand on artificially prepared sites, part in bank, part in cutting. Frequently an underground floor or basement of a house facing one street is entered as a ground floor from the street or alley next below.* With this partial exception, basements or cellars under houses are unknown.

Building material.

25. The usual building material is a blue Canton brick, not unburned, as often stated, but fired in a closed kiln, whereby the blue colour is produced. As ordinarily imported these bricks are soft and very porous, but they can be procured of good quality.

Red bricks can be obtained, but being more expensive, are rarely used. Granite from the local quarries is largely employed for door jambs and lintels over shop fronts. It is also used in the form of ashlar in the fronts of the more pretentious buildings.

Most houses are plastered, a few are faced with selected blue bricks rubbed smooth and neatly pointed according to the Chinese custom.

Roof covering.

26. The usual roof is of segmental tiles, with semicircular tiles covering the vertical joints, forming ridges, which often terminate at the eaves in ornamental glazed earthenware finials. In better classes of house an inner layer of segmental tiles is laid, with butt joints on the battens, to form a ceiling; on this is a course of tiles laid with lap joints. The vertical joints of this layer are covered with ridge tiles as before described.

Floors and pavement.

27. For the ground floor unglazed red tiles are used; frequently, however, there is nothing but rammed earth. Cookhouses and alleys are paved with granite blocks. Upper floors are made of China fir planks supported on round rafters, flattened above and below, to receive the planks and ceiling, if there be one.

European ouses.

28. Concerning European dwellings little need be said. They are substantial structures, often standing detached, with arched masonry verandas. The observations to be made on the drains of Chinese houses, but too frequently apply with almost equal force to them also.

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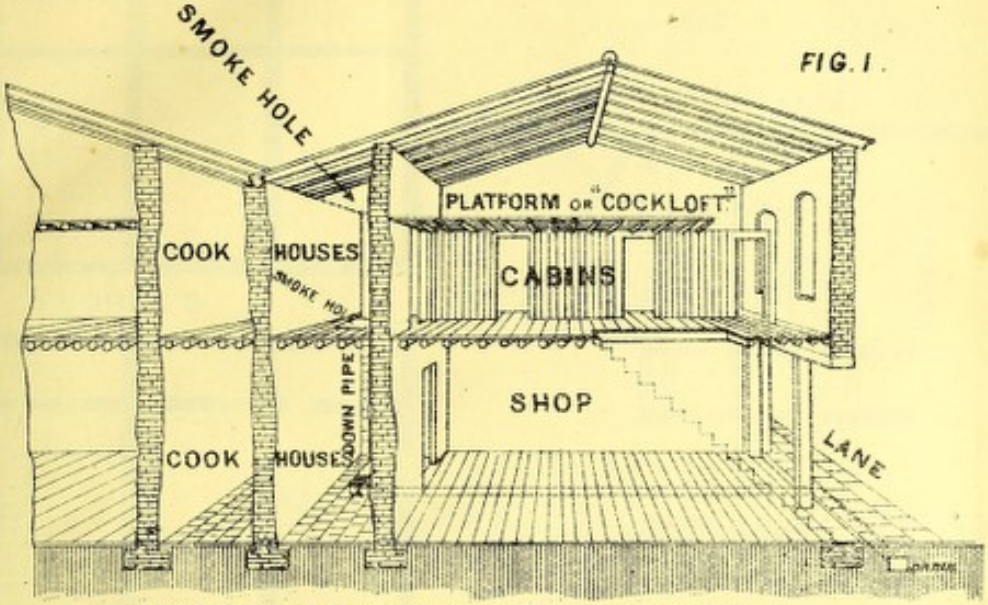
* Figs. 9, 10, Sheet II.; Fig. 17, Sheet III.; Fig. 22, Sheet IV.; Fig. 25, Sheet V.; Fig. 29, Sheet VII.

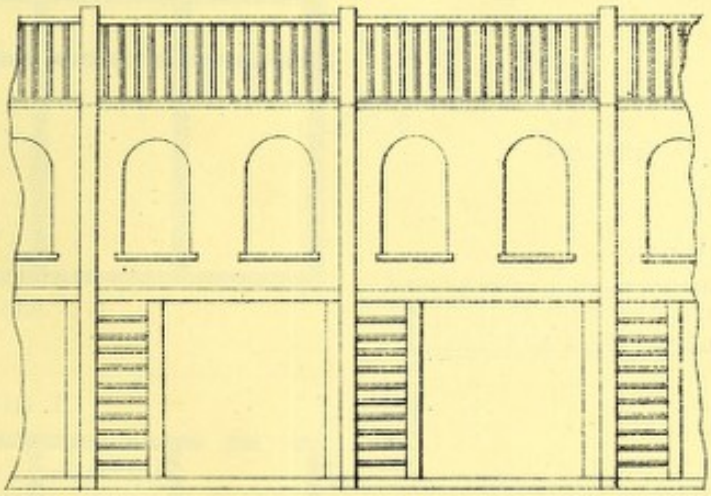
HOUSE Nº 2. KAIMING LANE.

FIG. 1.



SKETCH SHEWING INTERIOR OF HOUSE.

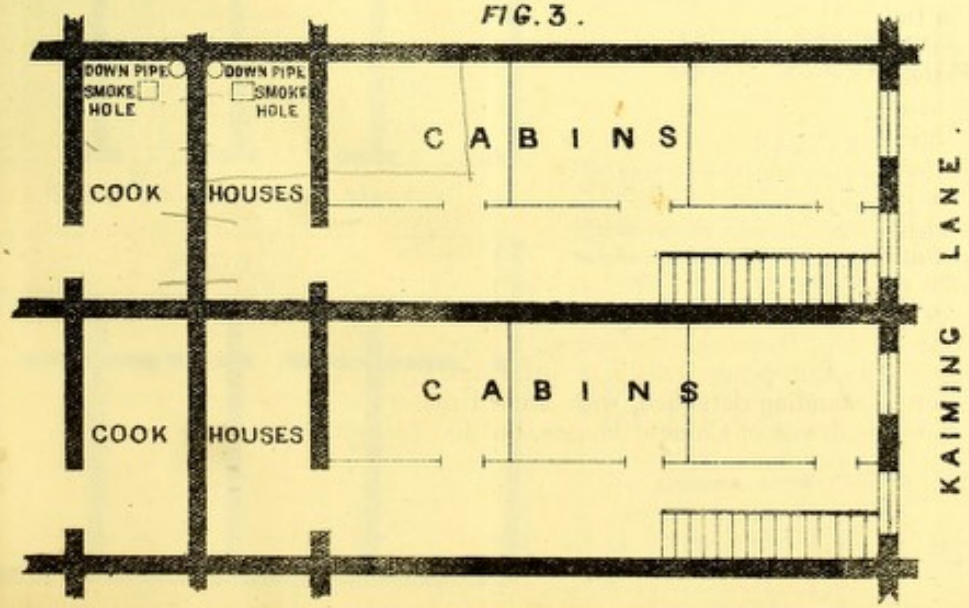
FIG. 2.



On First Floor 5 families = 16 persons
Space per head exclusive of
Cookhouse 137½ Cubic feet.

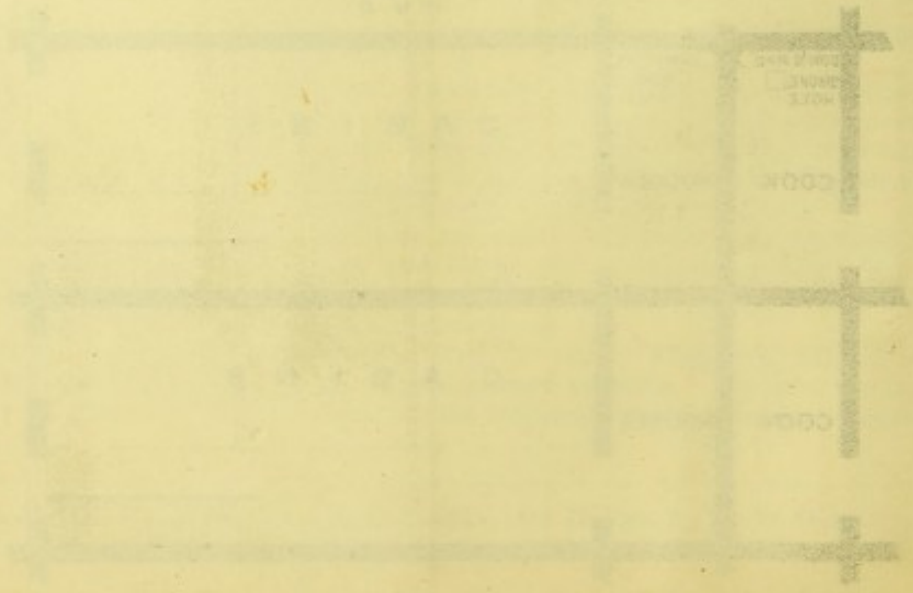
FRONT ELEVATION.

FIG. 3.



PLAN OF UPPER FLOOR.

DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN 1850.



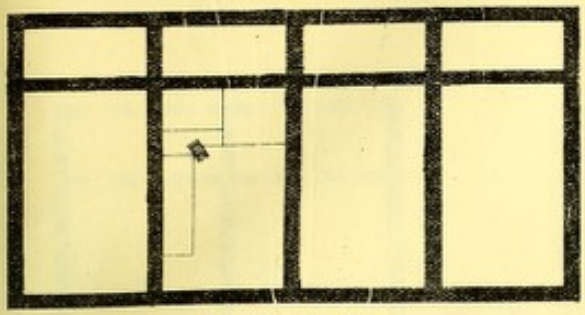


FIG. 4.

FLOOR B.

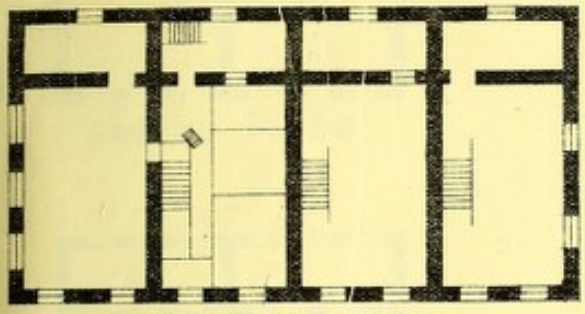


FIG. 5.

FIRST FLOOR PLAN.

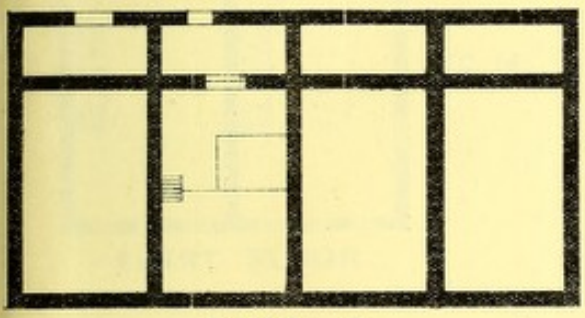


FIG. 6.

FLOOR A.

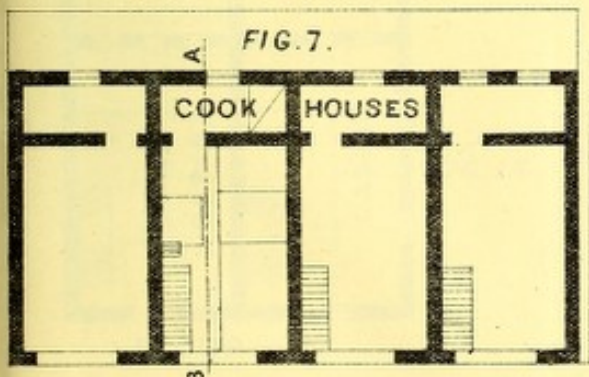


FIG. 7.

GROUND FLOOR PLAN.

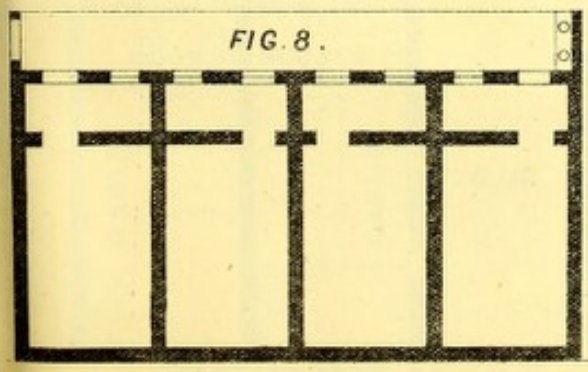


FIG. 8.

BASEMENT PLAN.

FIG. 9.

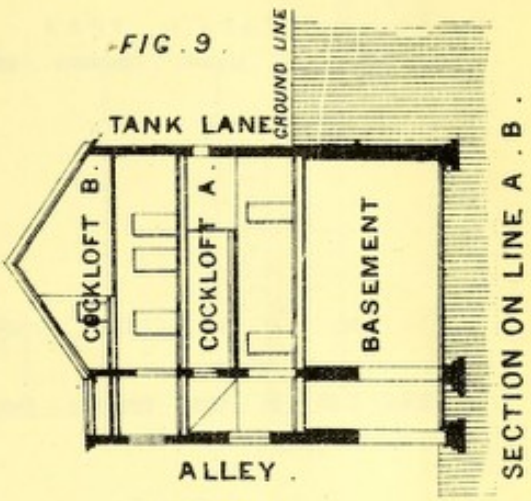


FIG. 10.

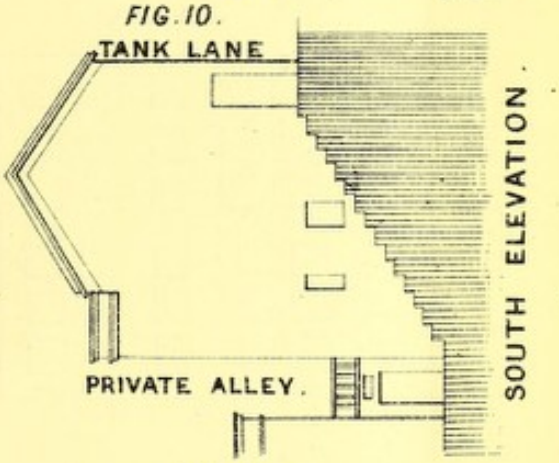
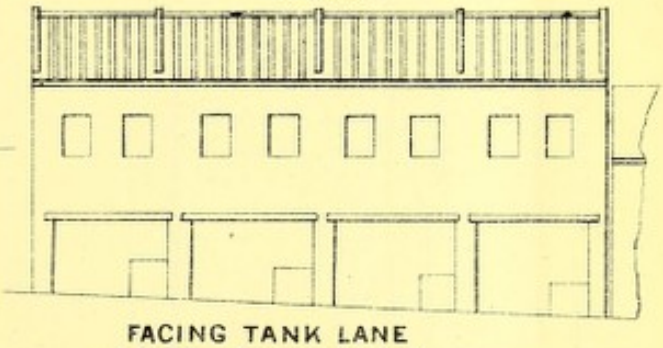
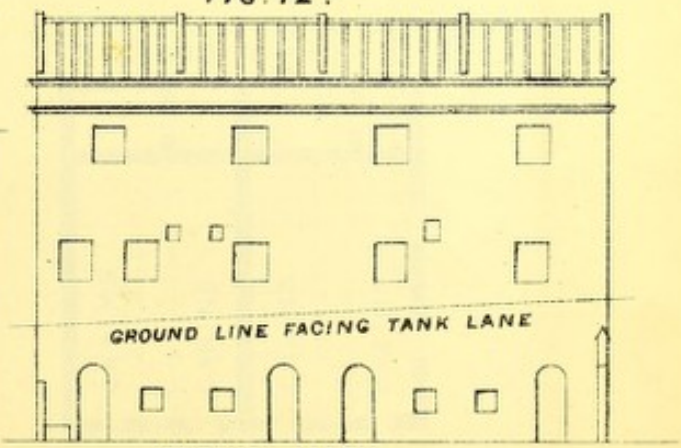


FIG. 11.



FACING TANK LANE
EAST ELEVATION.

FIG. 12.



FACING ALLEY
WEST ELEVATION.

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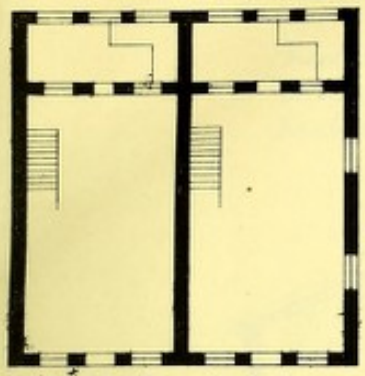


FIG. 13.

SECOND FLOOR.

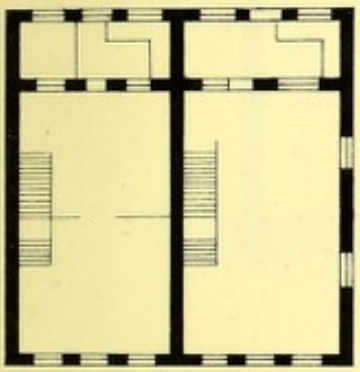


FIG. 14.

FIRST FLOOR.

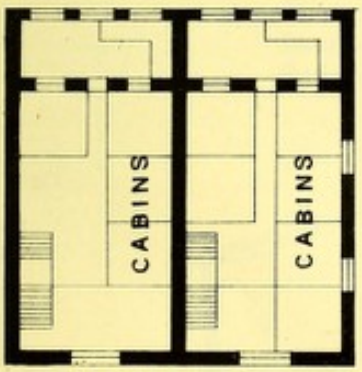


FIG. 15.

FLOOR C.

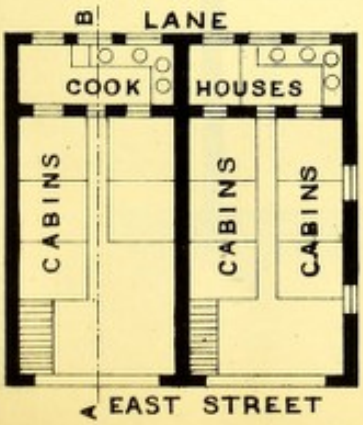


FIG. 16.

FIG. 17.

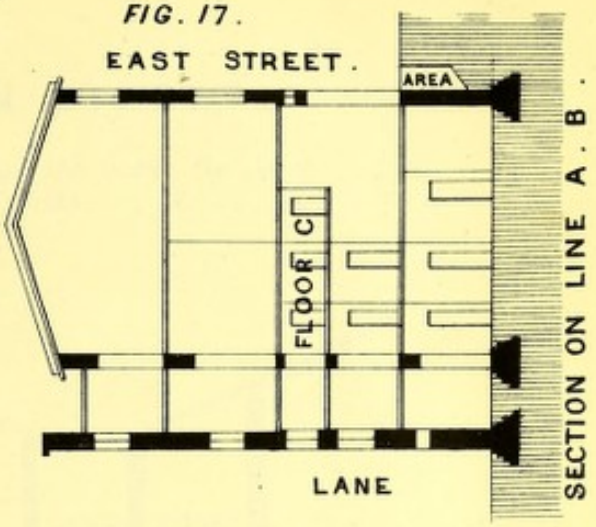
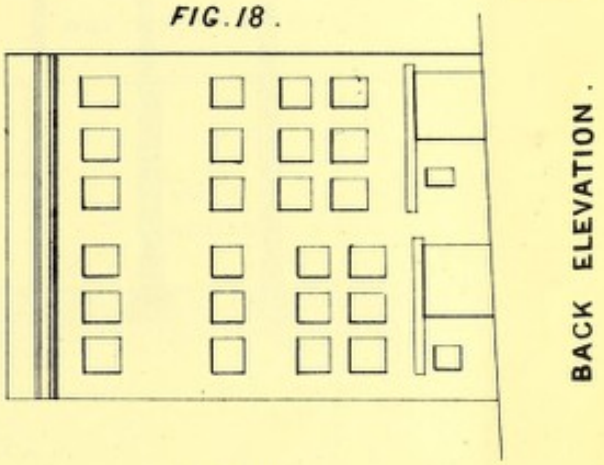
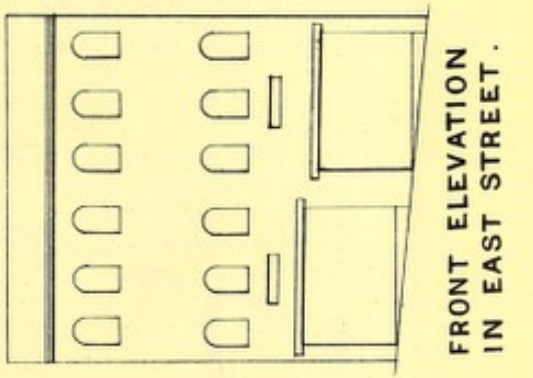


FIG. 18.



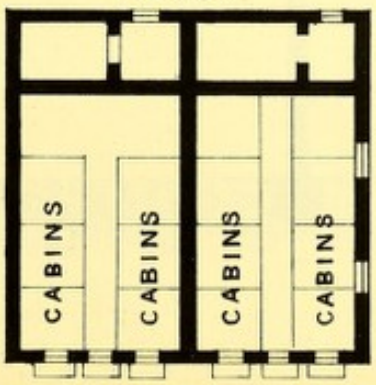
BACK ELEVATION.

FIG. 19.



FRONT ELEVATION IN EAST STREET.

FIG. 20.



BASEMENT PLAN

DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN. 4630

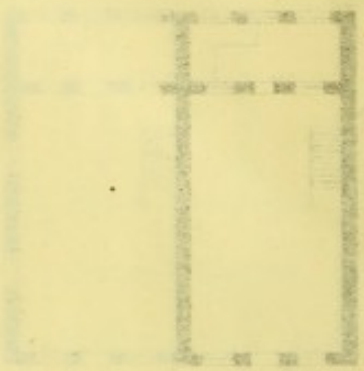


FIG. 21.

Nº 22 STATION STREET.

First Floor 33 persons 144 cubic feet each
Ground Floor 36 do 133 do do
Exclusive of Cookhouse

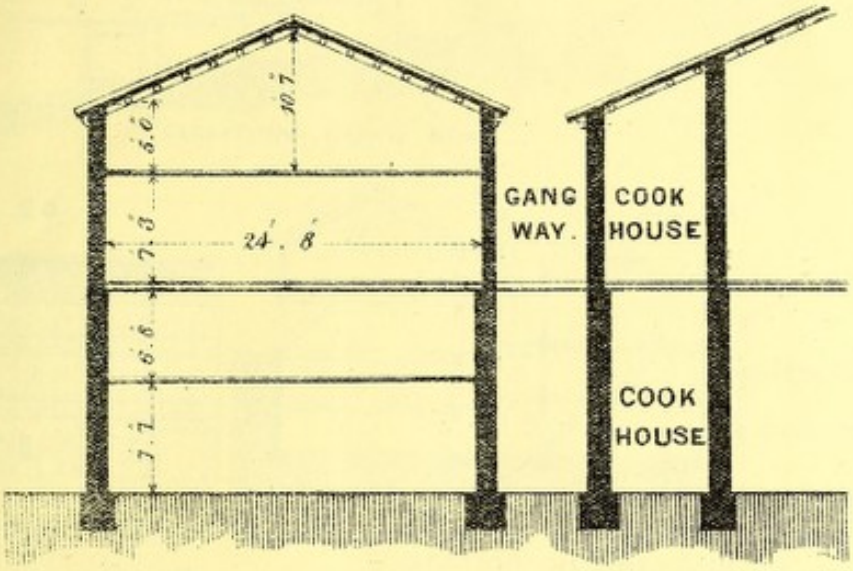
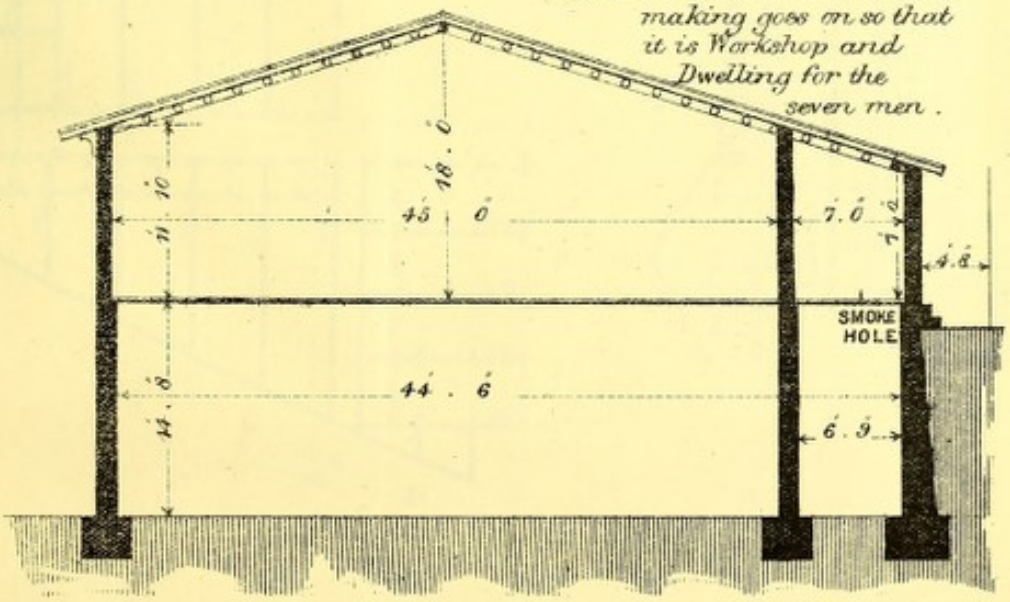


FIG. 22.

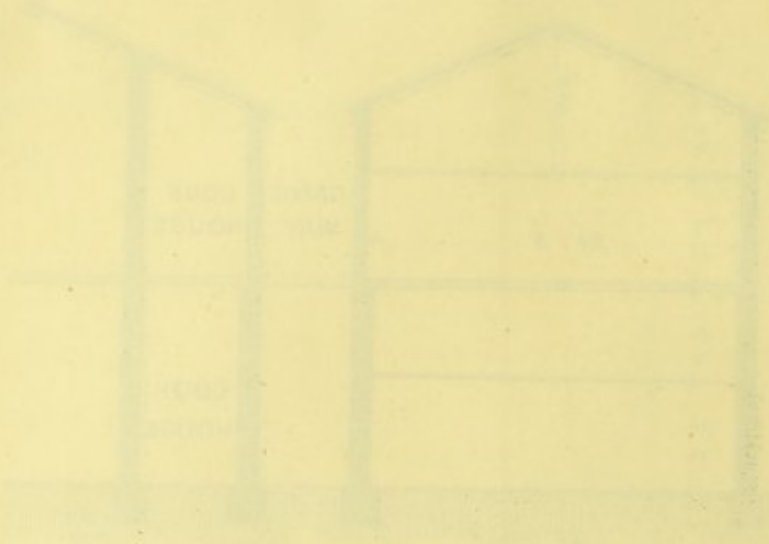
Nº 22 MARKET STREET.

First Floor 25 persons 400 cubic feet each
Second Floor 7 do 1337 do do
Exclusive of Cookhouse

NOTE. *On Ground Floor, chair making goes on so that it is Workshop and Dwelling for the seven men.*



DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 4250.



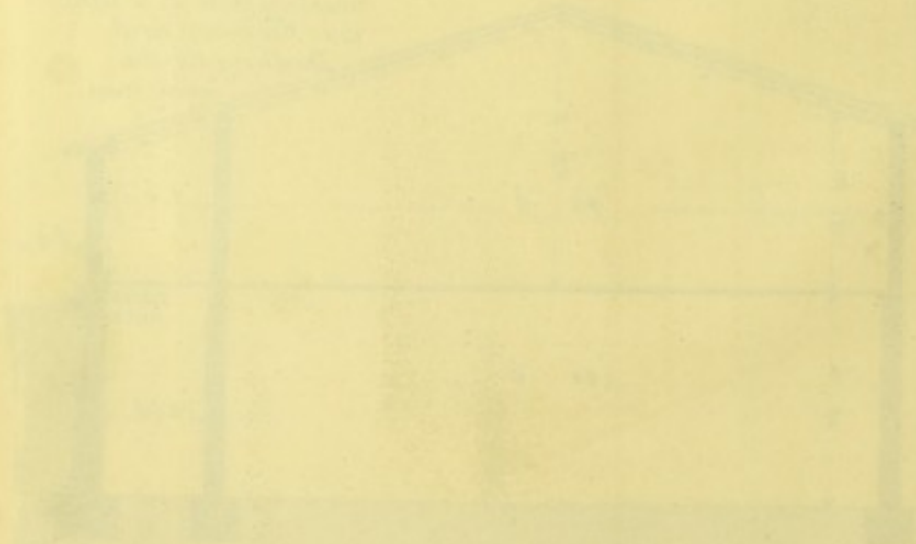
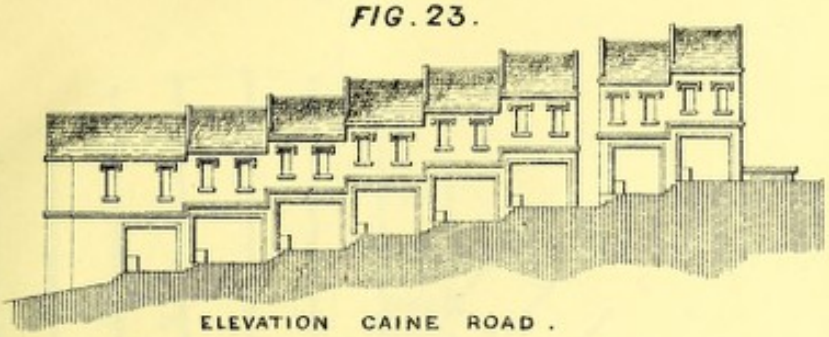


FIG. 23.

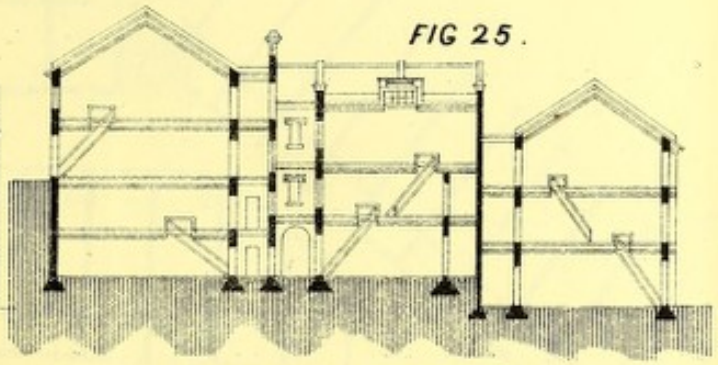


ELEVATION CAINE ROAD.

FIG. 24.

LEVATION TAIPINGSHAN STREET.

FIG 25.



SECTION ON LINE A.B.

TAIPINGSHAN STREET.

FIG. 26.

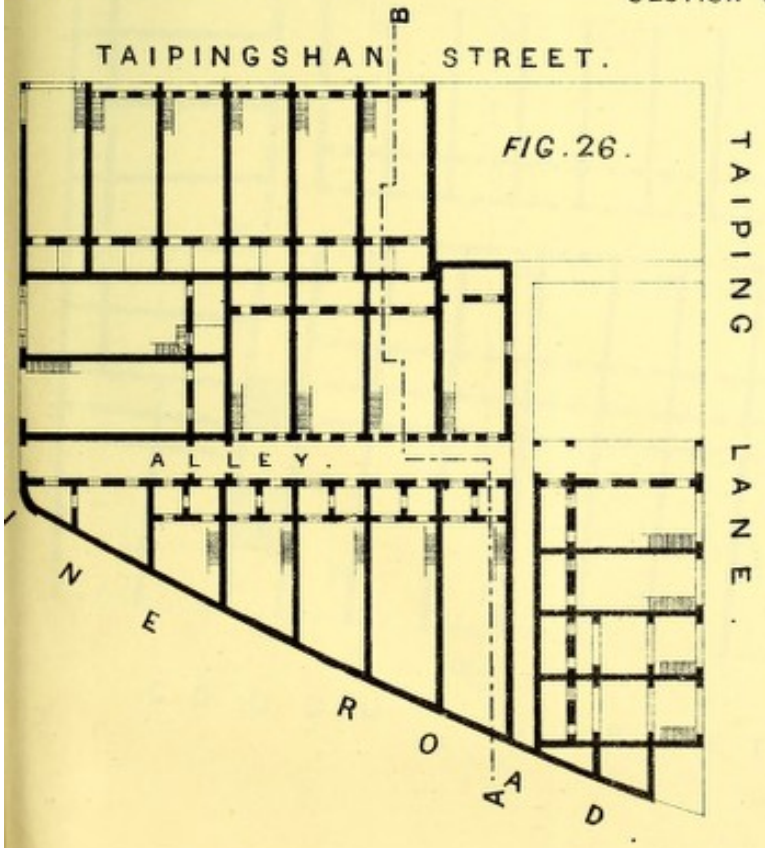
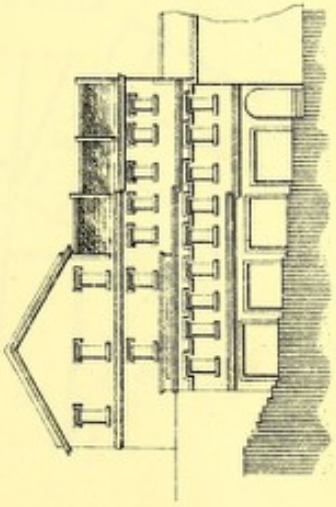


FIG. 27.



ELEVATION TAIPING LANE.

SCALE. 40 Feet = 1 Inch.

DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 4229

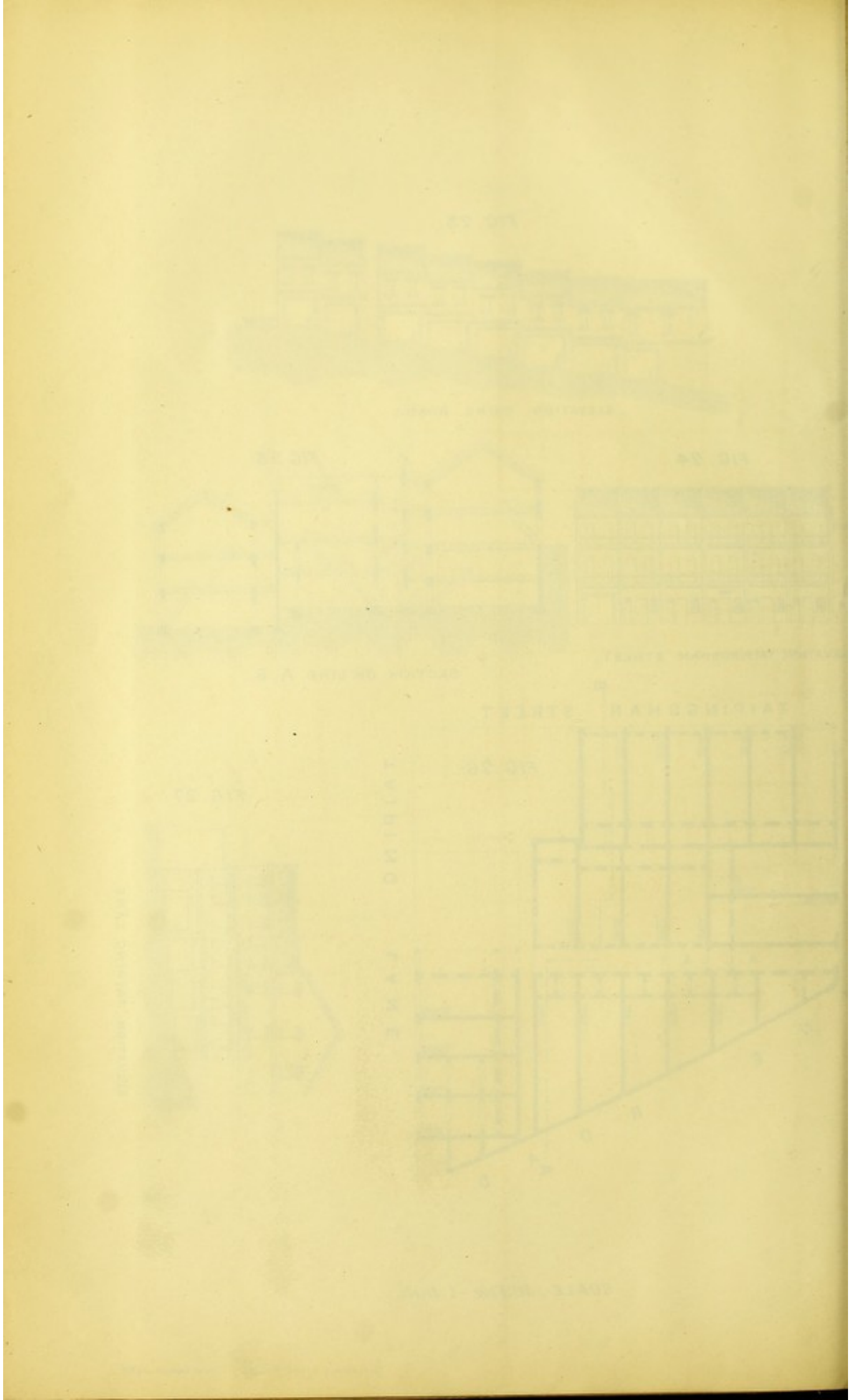
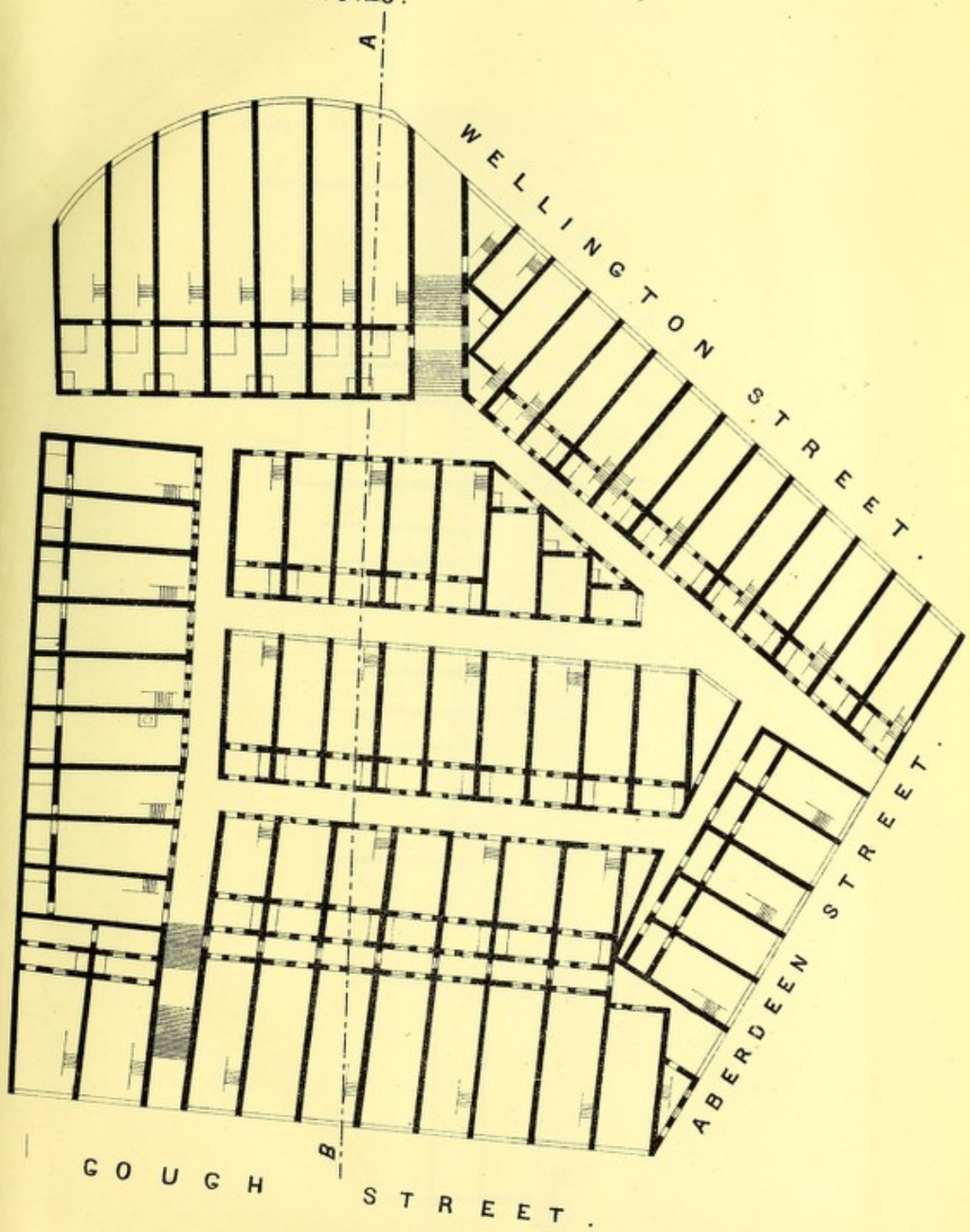
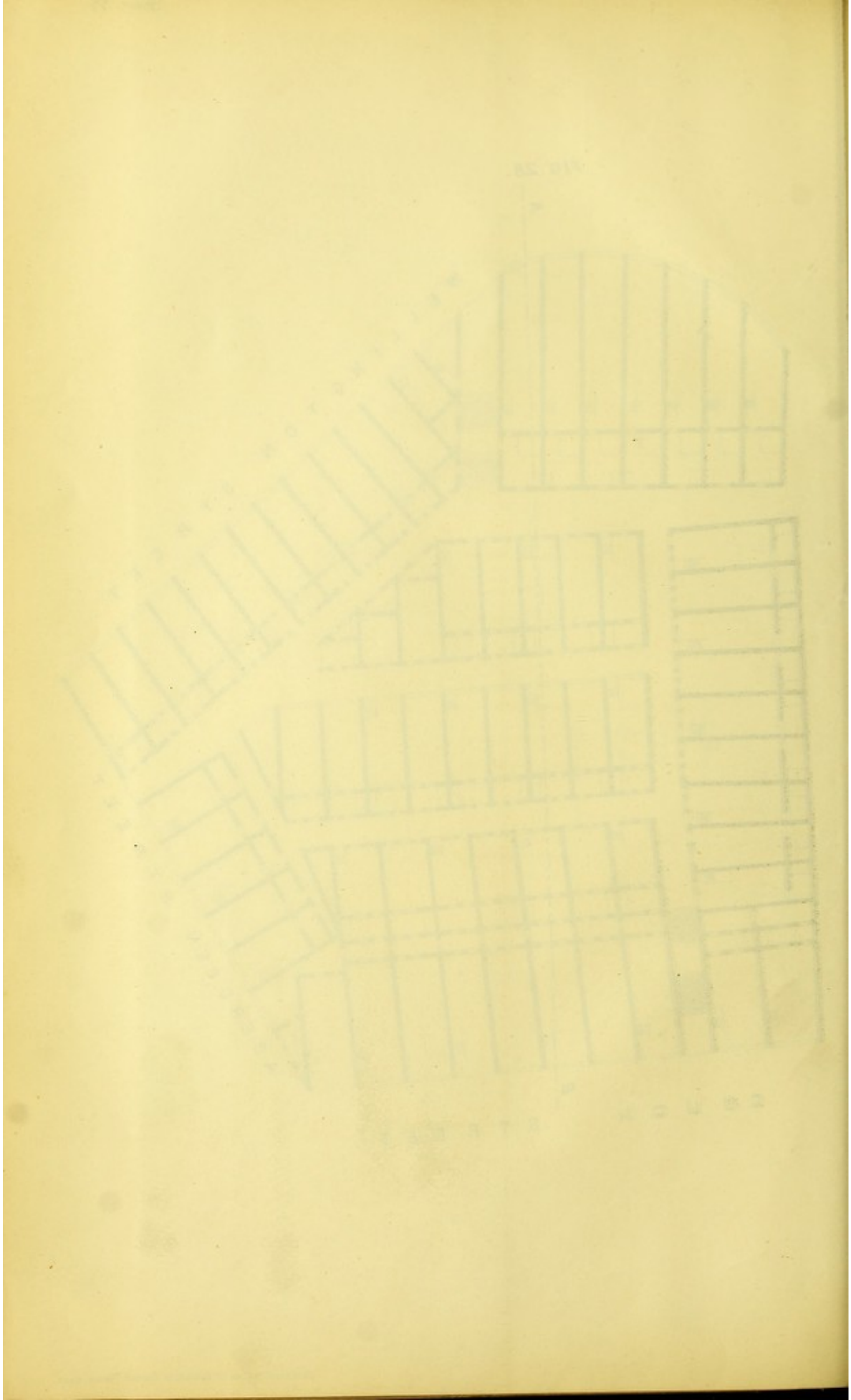


FIG. 28.



DANGERFIELD LITH. 22, BEDFORD ST. COVENT GARDEN 4229



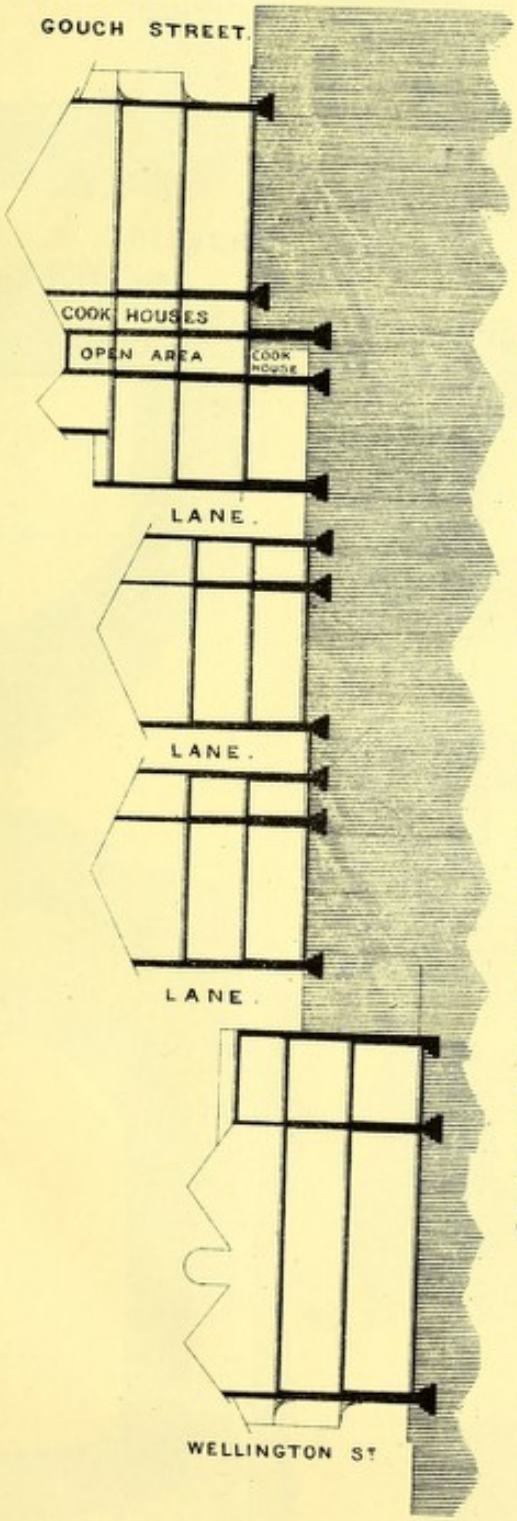
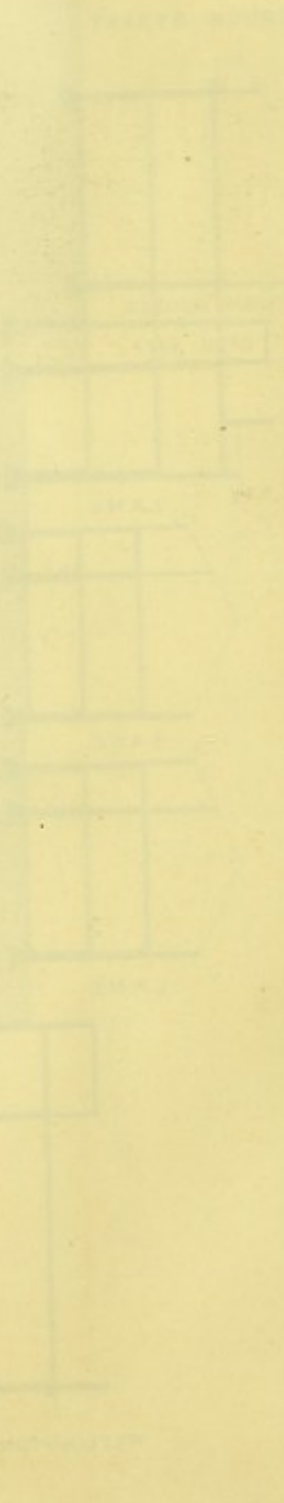


FIG. 29.

SECTION THROUGH INLAND LOT N° 8 ON LINE A. B.

SCALE 40 Feet = 1 Inch.

DANGERFIELD, LITH. 22, BEDFORD St. COVENT GARDEN.



EXAMPLES OF SEWERS

LADDER STREET DRAIN.

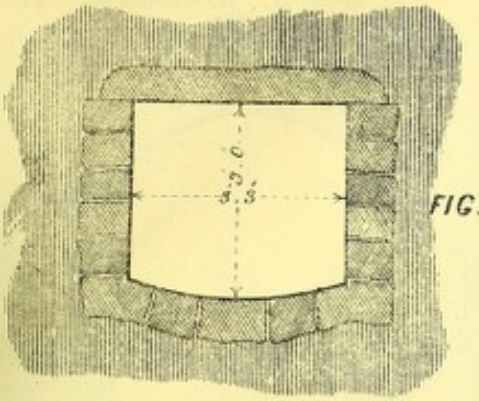


FIG. 30.

WATER LANE DRAIN.

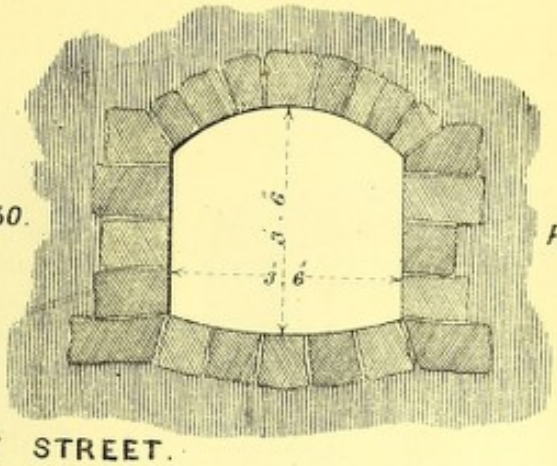


FIG. 31.

CLEVERLY STREET.

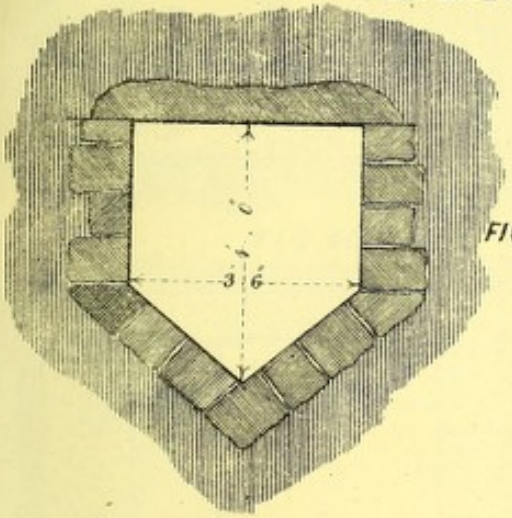


FIG. 32.

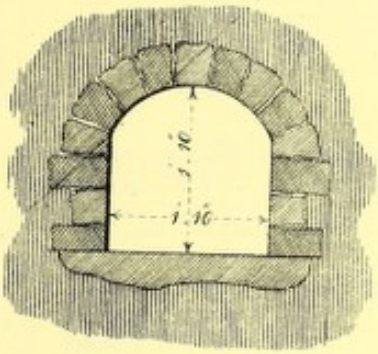


FIG. 33.

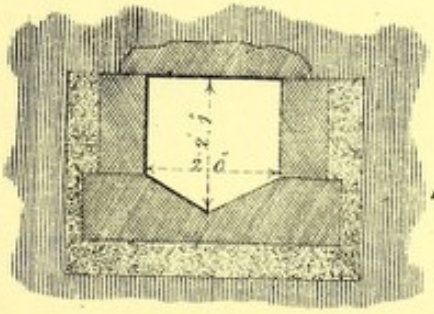


FIG. 35.

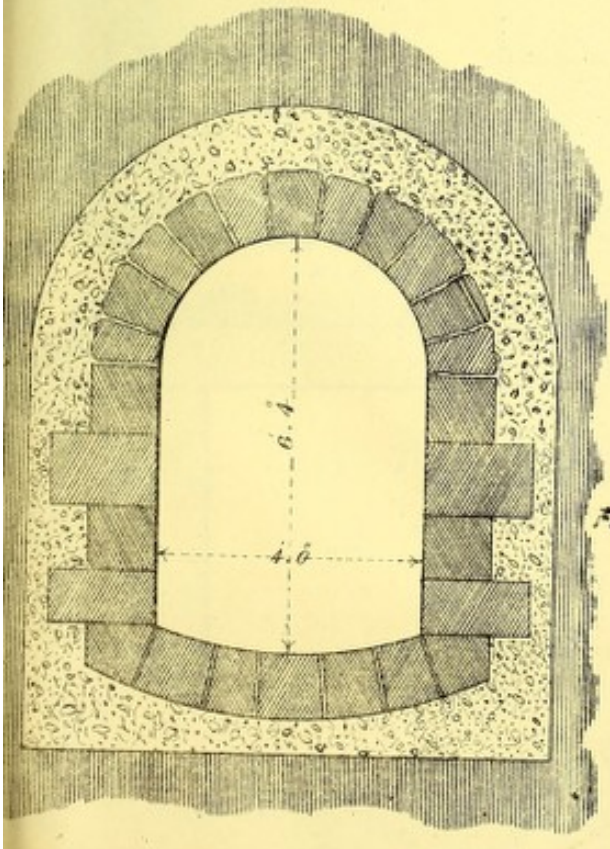


FIG. 34.

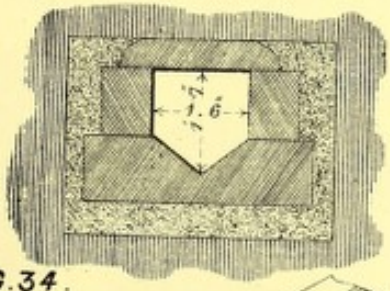


FIG. 36.

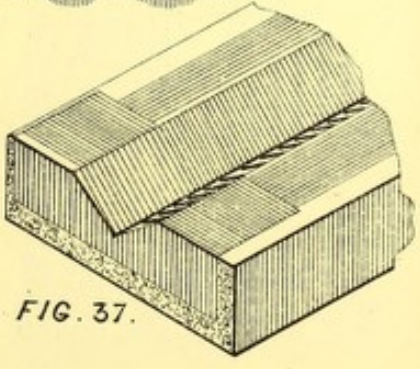


FIG. 37.

DANGERFIELD LITH. 22 BEDFORD ST. COVENT GARDEN 4229.

Shewing method of improving the existing sewers.

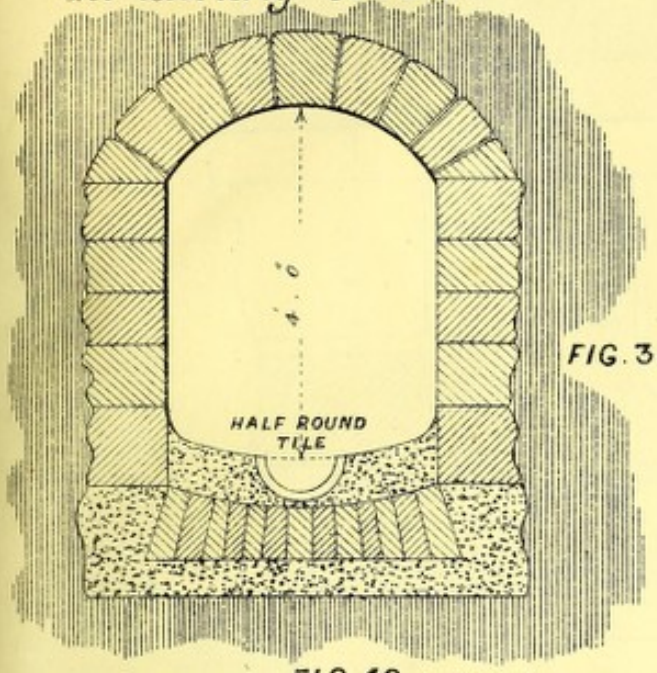


FIG. 38.

FIG. 39.

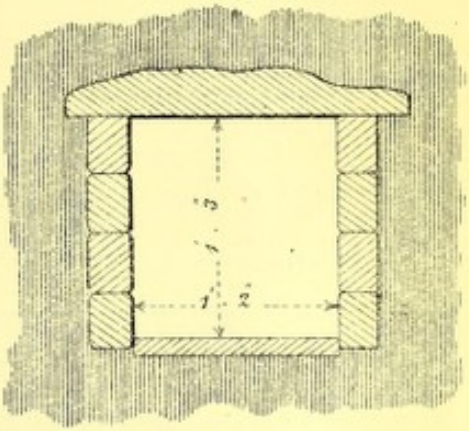


FIG. 40.

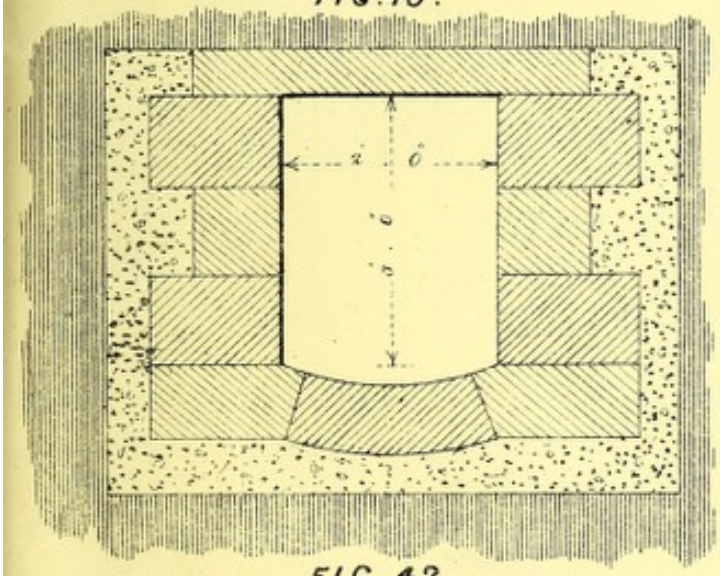


FIG. 41.

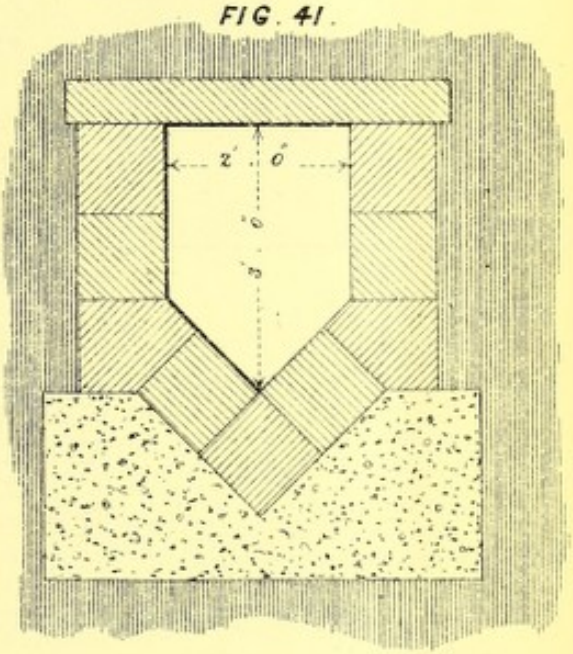


FIG. 42.

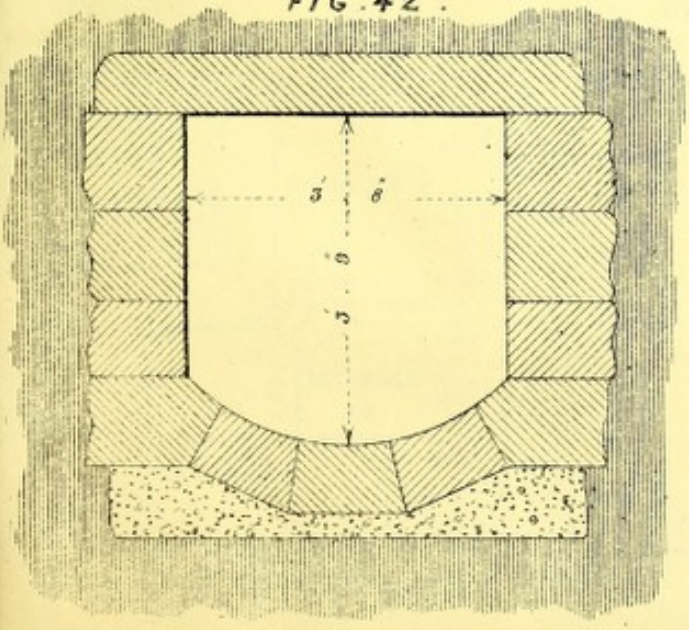
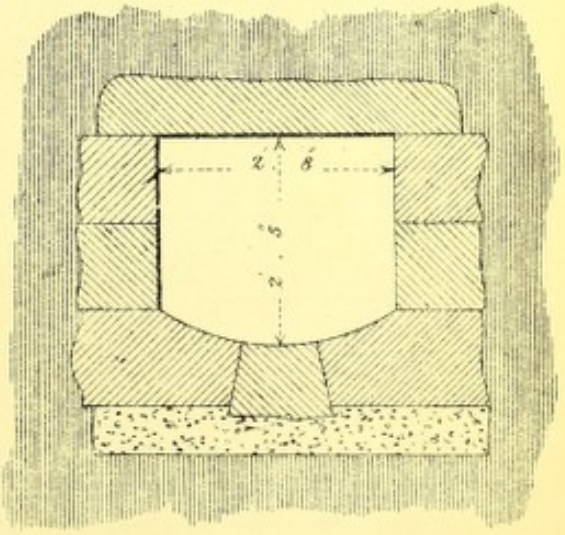
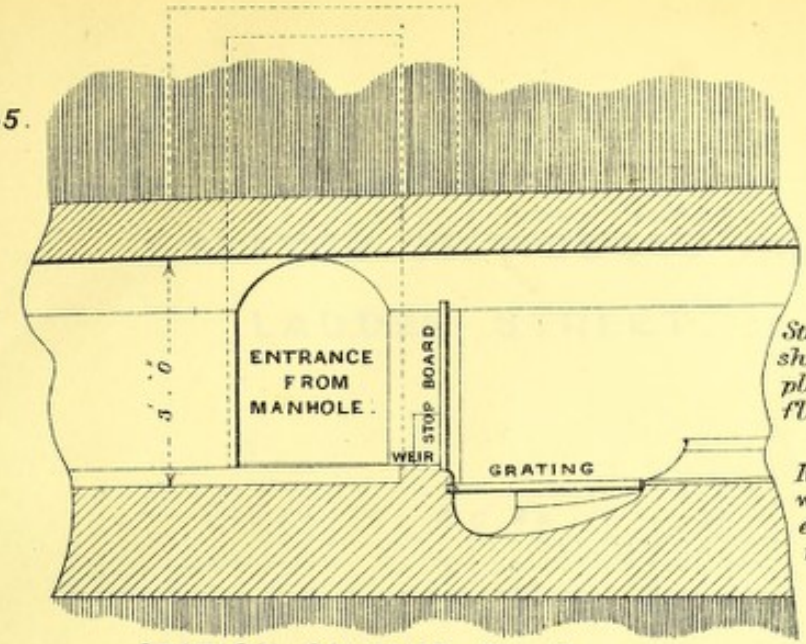


FIG. 43.



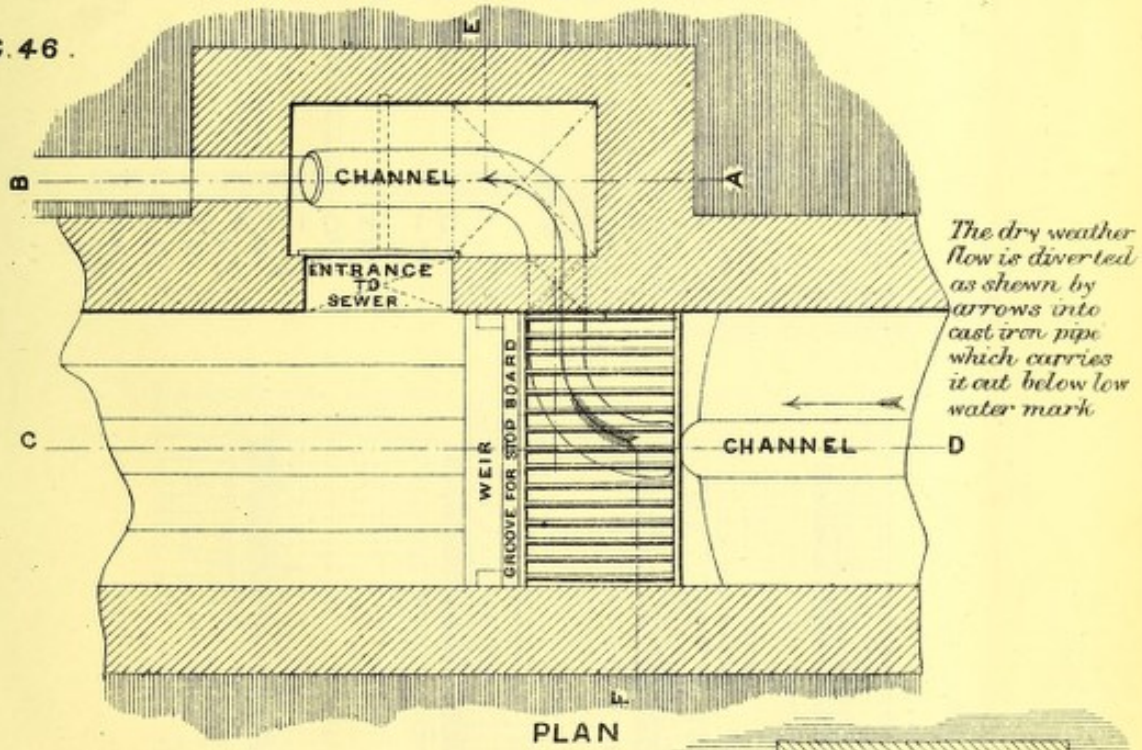
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 4246

FIG. 45.



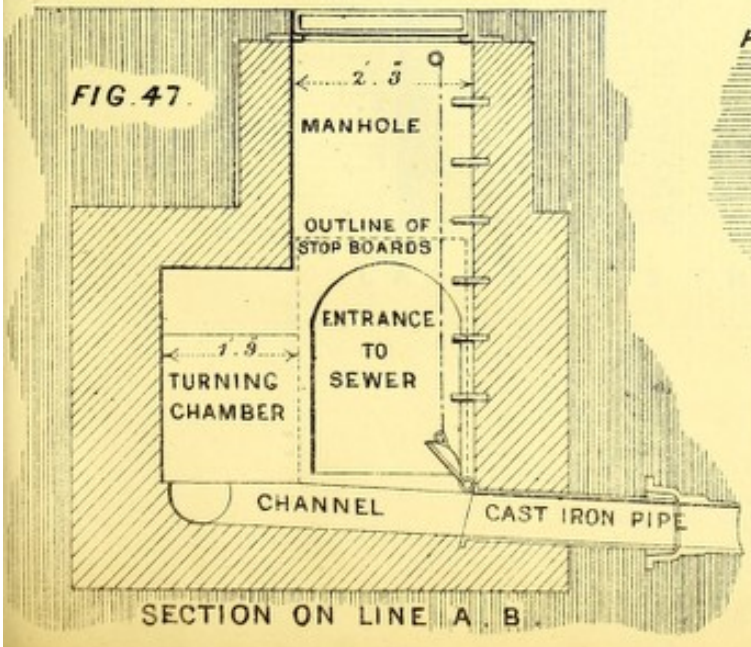
SECTION ON LINE C. D.

FIG. 46.



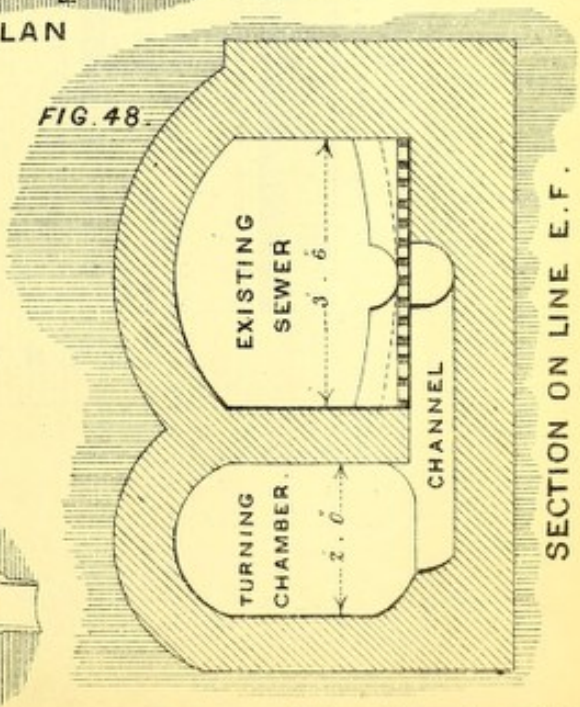
PLAN

FIG. 47.



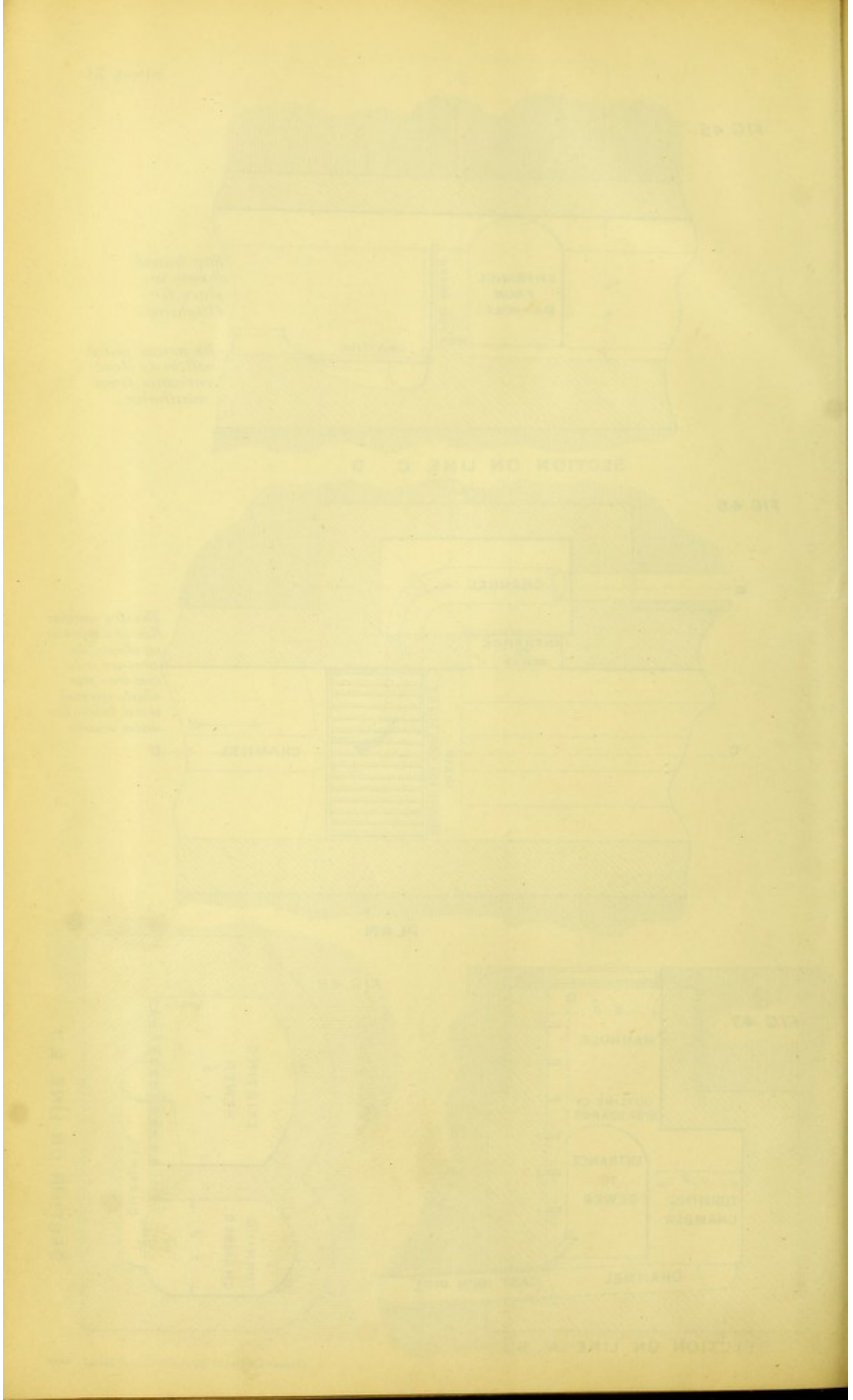
SECTION ON LINE A. B.

FIG. 48.



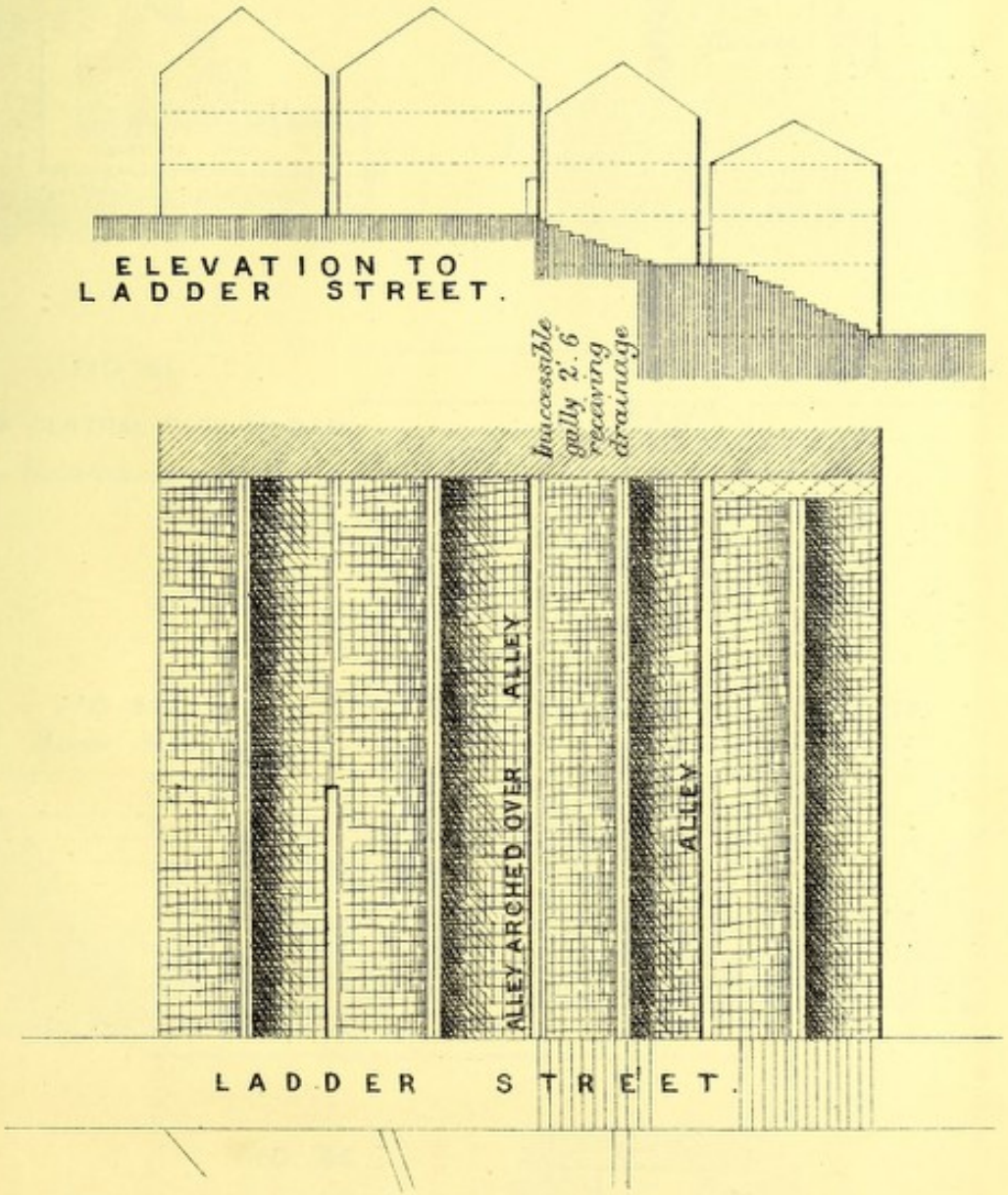
SECTION ON LINE E.F.

DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 4028



SKETCH OF HOUSES IN LADDER STREET.

FIG. 44.



Damerfield Lith. 22 Bedford St. Covent Garden. 4228

MASONRY DAM ACROSS NULLAH

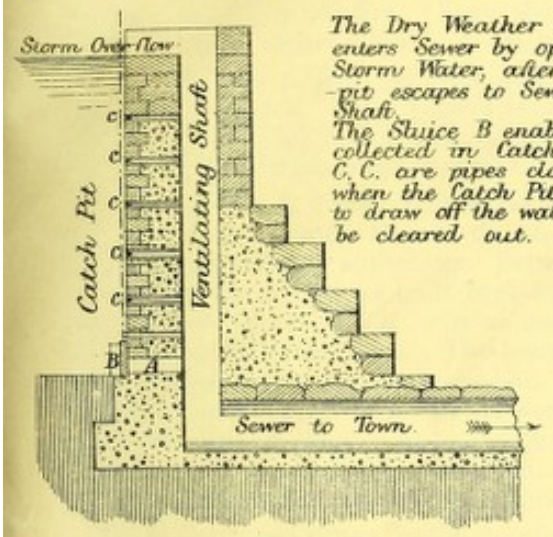
At Inlet of Sewers above Town

Serving as Catch-pit to Retain debris and silt

And also as a Ventilating Shaft.

FIG 49.

SECTION ON LINE A.B. THROUGH VENTILATING SHAFT.



The Dry Weather Flow of Nullah enters Sewer by opening A: Storm Water, after filling the Catch-pit escapes to Sewer by the Ventilating Shaft.
The Sluice B enables Water to be collected in Catch-pit for flushing. C. C. are pipes closed by plugs which, when the Catch Pit is full of silt serve to draw off the water to allow it to be cleared out.

FIG 50.

GENERAL SECTION OF DAM.

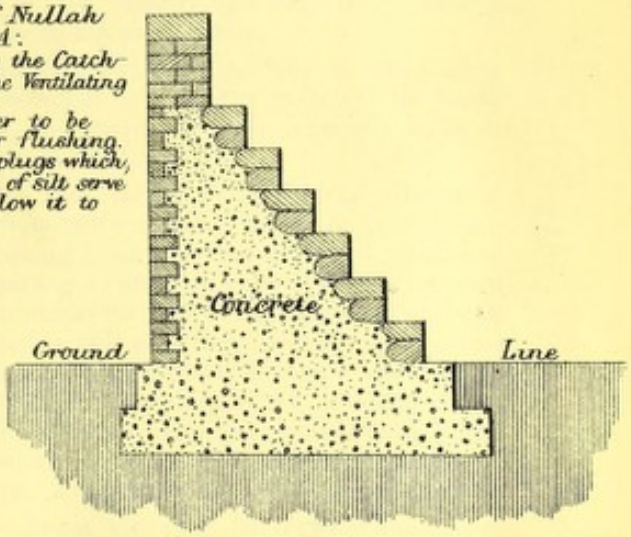


FIG 51.

PLAN OF CENTRAL PART OF DAM

Shewing Ventilating Shaft.

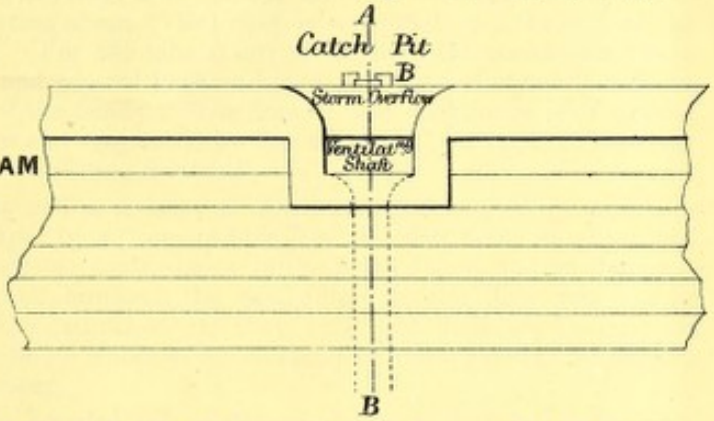
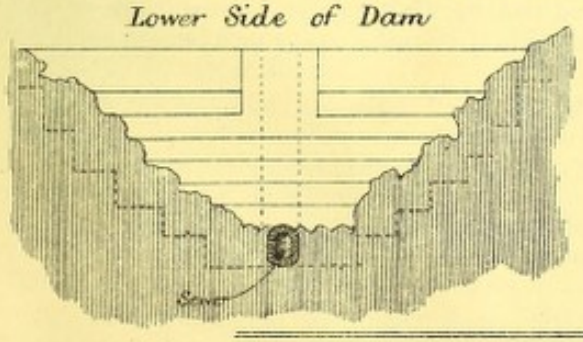


FIG 52. SECTIONS OF NULLAH FIG 53.

Lower Side of Dam



Upper Side of Dam

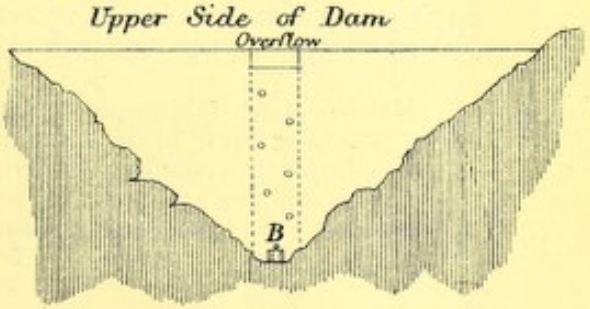
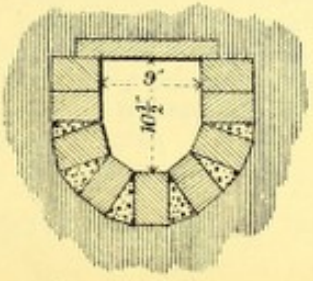


FIG 54.

Half Barrel Brick Drain



DANGERFIELD. LITH. 22 BEDFORD ST. COVENT GARDEN

29. The usual type of Chinese house in Hong Kong is essentially different to that in use on the neighbouring mainland. This is due to some extent, no doubt, to European influence and example, but principally to the necessity for economy of space on account of the high price of land and the great cost of preparing level sites for building. This shows that the Chinese are not so averse, as commonly supposed, to change their habits to suit altered conditions.

The type of Chinese house in Hong Kong is quite different to that in China.

30. According to immemorial custom, in one respect at least, the street frontage of the house is narrow, being 13 to 16 feet only. The depth back from the street is large, varying from 30 to 60 feet. Even the houses of the wealthy are formed by uniting several of these narrow units by doors or archways in the party walls.

Ground plan of house, small frontage, and great depth.

31. If the site be level the houses are often built back-to-back, no lane or space being left between them.* If the ground be sloping there will be a lane or gulley at the back, often not more than 5 feet wide, sometimes less, and frequently this lane will be at or near the level of what is the first floor in the street in front.†

Arrangement of house to suit ground. Back-to-back houses. Lanes. Partial basement floors.

32. Figures 1, 2, 3 give the general appearance and leading dimensions of a house in Kai-ming Lane, Canton Bazaar, the district so frequently referred to in the correspondence with the military authorities. Between Kai-ming Lane and that next and parallel to it, are two rows of houses built back-to-back, having a common back wall, and no open space between them. This is by no means an unusual method of building, especially in the flatter parts of the town. The house depicted in this sketch is a fair specimen of its class, and was selected quite at random. The ground floor in front is completely open to the street, and is used as a shop or workshop, but in it the shopkeeper or some of his assistants usually sleep. At night the front is closed by upright wooden bars, fitting into sockets in the threshold and lintel, behind which again, in cold weather, shutters are placed. The floor in this case is of rammed earth.

Description of house in Canton Bazaar Back-to-back construction. Figs. 1, 2, 3.

33. In the house shown in the drawing, as in almost all other dwellings at the rear of the building, on each floor a portion about 7 feet deep is separated from the rest of the house to form the "cookhouse." For the inhabitants of the floor the cookhouse has to serve as kitchen, latrine, urinal, and general backyard, and in it not unfrequently may be found the bed of some member of the family. The floor of the cookhouse is of granite blocks. Usually it is broken up and disjointed by the efforts of the cook to raise the sink stone to clear the drain or by splitting firewood.

Cookhouse and its various uses.

34. In back-to-back houses, as well as in some of other construction, the ground floor is ventilated and the smoke escapes by a "smoke-hole" in the first floor, usually about 4 or 5 feet square. There are similar smoke-holes in the floors above, and in the roof. In the house shown in the sketch, however, the smoke hole in the floor was but 12 inches square. Chimneys are the exception. If they exist but little smoke goes up them, the greater part, if there be no smoke-hole, escaping by the windows, blackening the walls in a most unsightly manner.

Smoke-hole. Want of chimneys.

35. Very frequently a space is boarded off on the ground floor in front of the cook house, forming a store or bedroom. Often a sort of platform or gallery is erected above this, on which several artisans work at their benches, or on which several beds are made. From the ground floor again, a further portion is cut off, containing the narrow steep stair, leading to the upper floors.

Arrangement of ground floor.

36. In the house in Kai-ming Lane, like the great majority of dwelling-houses, the upper floor is divided off by board partitions into cabins about 9 feet long and 10 feet wide. Each of these forms the dwelling of an individual or family. These cabins do not extend to the full height of the storey. On the contrary they are but about 7 feet 8 inches high; for in order further to economise space a platform or floor, locally known as a "cockloft," is constructed above them. The cockloft is almost universal in dwellings of the middle and poorer classes.

Arrangement of upper floor.

37. In this house in the upper floor only there were five families including 16 souls. There were here three cabins and a platform extending over them, and over the passage. Hence the total cubic space per head was 437½ cubic feet, and this includes the *whole* domestic accommodation, with the exception of the cookhouse, and not sleeping room only, which in the case of the cabins does not exceed 130 cubic feet per head. It must be remembered that the lower floor rarely belongs to the inhabitants of the upper floors. Very frequently each floor is leased separately from the owner, or from his "comprador," and sublet again to individual lodgers.

Number of inhabitants. Cubic space.

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* Figs. 1, 2, 3, Sheet I.

† Figs. 9, 10, Sheet II.; Fig. 17, Sheet III.; Fig. 22, Sheet IV.; Fig. 25, Sheet V.; Fig. 29, Sheet VII.

Upper floor.

38. The wooden floor of the upper storey is usually encrusted with mud, for the boards are so loosely jointed that it could not be washed without deluging the people below, even were water available for the purpose, which is seldom the case.

Description of house in Peel Street inhabited on ground floor.

39. In some parts of the town the ground floor also is used as a dwelling. In a house in Peel Street having a frontage of 15 feet and a depth of about 50 feet, the ground floor was divided into four cabins about 10 feet by 10 feet each, inhabited by a family. The head man of this floor was a fireman aboard a local steamer; he paid the rent to the landlord for the whole floor ($8.50 a month). Inhabiting one cabin himself, he sublet the remaining three. The first floor also was divided into four cabins and occupied by 13 persons; the second floor was occupied by 11 persons, small traders from Shanghai. This house, situated in one of the better streets, is certainly above the average in point of accommodation.

Latrines and ashpits do not exist, though Building Ordinance directs this construction.

40. Notwithstanding that Ordinance 8 of 1856 directs that, "every house shall be "provided with a latrine or privy and ashpit . . . . to the satisfaction of the "Surveyor General," anything satisfying the most modest requirement as to such appliances, is very rarely to be found. In the houses of the poorer classes they do not exist, unless indeed a pot placed in the corner of the cookhouse, sometimes enclosed by a few boards, may be considered to be a latrine within the meaning of the Act. This subject will be treated more fully under the head of scavenging.

Underground house drains, their arrangement, material, and construction.

41. To carry off slopwater, a drain leads from a sink in the cookhouse to the public sewer. The arrangement of these house drains varies so considerably, that it is impossible to determine any general rule of construction, for very often their course and position cannot be ascertained.

Sometimes each house has an independent drain running out under the floor to the street in front. More often the drain runs from cookhouse to cookhouse, under the party walls of adjacent tenements, till it reaches the end of the row, or is brought out under some one house to the front. Sometimes, but very rarely, the drain runs along a back alley. Not unfrequently private house drains traverse several distinct lots, or properties, on their way to the public sewer. It does not appear to be the practice to make provision for this state of things by easement or otherwise in deeds of transfer. Consequently, if one or more houses out of a row having a common drain are sold and reconstructed, the remaining houses may be deprived of their outlet to the sewer. (Example lot 83 and Heung Lane, among others.)

Materials and construction of house drains.

42. For house drains, brick (often the inferior blue brick), is the usual material. It is set in common mortar, and sometimes bedded in concrete, but not often. The best form of house drain in use is a 9-inch half-barrel drain covered with a flat tile (see Fig. 54, Sheet XII.). Square brick drains are more common, with flat tile soles and covered with flat tiles. Down some alley-ways a private drain about 2 feet 6 inches by 1 foot 6 inches runs, the granite covering slabs forming the pavement of the alley, the open joints of which freely permit the escape of the emanations from the filthy black deposit with which they are filled. (Example Heung Lane, Wai-Wa Lane.)

Connexions to main sewers made by Government, but no control exercised over remainder of work.

43. Of late years the Government have made the connexion to the main sewer, and constructed the house drain up to the front wall of the house. The remainder of the drain has been left to the uncontrolled intelligence of the Chinese builder. No care whatsoever is taken as to line, gradient, or workmanship.

In February last a *new* drain was being constructed in the following manner. The drain was square 1 foot 2 inches wide by 1 foot 3 inches high. The sides were of brick *on edge*, and did not rest on the tile which formed the sole. See Fig. 39 Sheet IX. Under these circumstances it need hardly be said that a great proportion of house drains are but elongated cesspools, the greater part of their fluid contents filtering into the subsoil. In one case a drain was found having no bottom but the natural soil.

Narrow gulleys and inaccessible spaces betweenhouses.

44. Instances are to be found, where the outer wall of one property is built so close to that of the adjacent house, as to leave an inaccessible space between them, which serves as an open drain. In one case the space between two houses was but 8 inches wide, and it received the filth from windows of cookhouses looking into it (Cleverly Street).

Something similar was found in Josi Lane opening from Ladder Street. As the arrangement of the houses is characteristic, it is shown in Fig. 44, Sheet X. Here a drain certainly went down into the gulley, but what became of it afterwards could not be discovered.

Drainage of upper floors. Absence of

45. The slops from the upper cookhouses are conducted down by a pipe of rough earthenware, coated with plaster. Frequently this is inside the house, in which case it

simply delivers its flow on to the floor of the cookhouse below, as in the case of the house shown in Figs. 1–3, Sheet I. facilities for disposing of rubbish.

At other times it is put outside the house. As the upstairs lodgers have no convenience for getting rid of rubbish, much is stuffed into the down pipe, choking it, causing it to leak, and saturate the walls with the filthy fluid, oozing from its imperfect joints. For the same reason, the house drain also is frequently obstructed.

46. Trapping, disconnexion and ventilation of house drains, may be said to be unknown. The sewer gas has a free channel to the interior of the house, except when the drain is blocked up with filth. Even houses of Europeans may be found, where waterclosets and baths, within the house or in a veranda, are connected to the drains, without ventilation or disconnexion of the soil-pipe, and without any proper trap. Want of traps, disconnexion, and ventilation in drain.

47. The following examples will give an idea of the principal varieties of house construction. They are by no means extreme cases, some of the houses are quite new, and not yet fully occupied. These will illustrate the working of the Building Ordinance at the present time. Examples of house construction.

48. Figures 4 to 12, Sheet II., show the arrangement of a block of four houses in Taipingshan Street. They are of a somewhat different type to that just described, having a lane at the back of them, which is much lower than the street above, so that the basement is entered at the ground level from it, Figs. 9–10. The cross section, Fig. 9, shows the intermediate floors or "cocklofts," A and B, that have been constructed between the original floors, and the ground plans, Nos. 4, 5, 6, 7, 8, show the way in which they have been subdivided into cabins. Houses in Taipingsham Street.

49. The following is the number of inhabitants and the cubic space per head :— Number of inhabitants and cubic space per head.

—		No. 25.	No. 23.	No. 21.	No. 19.
Basement	No. of occupants	11	11	10	0
	Cubic space per head	604	604	665	—
Ground floor	Do. do. do.	Shop	7	15	30
	Do. do. do.	—	822	383	192
2nd floor	Do. do. do.	20	—	17	14
	Do. do. do.	308	—	339	441

50. Here each floor is lighted by two windows in front, and the cookhouse has also a window, by which the smoke principally escapes, but which is of little use to the main room. Lighting, ventilation, latrines, and drainage.

Bed places were found in the cookhouses. In one of these houses a space of not more than about 2 feet 6 inches square was boarded off beneath the narrow stair to serve as a latrine, that is to say, a pot was kept there. In other houses even this scanty accommodation was absent. The down pipes from the upper storey lead into the basement, one was burst and had flooded the place. The house drains lead out into the gulley at back, and thence their course could not be positively ascertained.

51. The pair of new houses shown in Figs. 13–20, Sheet III., are not yet fully occupied. They give a good illustration of the manner in which additional accommodation is gained by introducing floors after the building has been constructed. An ample space between floors is shown on the plans sent in for the approval of the Inspector of Buildings, which is after construction, halved by the introduction of the cockloft. In this case it will be observed that in the rear elevation there are *two* rows of windows on the ground floor. It seems more than probable, therefore, that the introduction of a "cockloft" was contemplated from the first and provision made for it in the design. Description of houses in East Street. Intermediate floors apparently contemplated in design.

The number of inhabitants, &c. was— Number of inhabitants and cubic space per head.

—	Basement.	Ground Floor.	1st Floor.	2nd Floor.	Basement.	Ground Floor.	1st Floor.	2nd Floor.
Number of rooms	8	12	Unoccupied	5	8	14	10	—
Number of people	10	22		11	16	41	15	8
Cubic feet per head	592	388		769	370	208	658	1,058

On revisiting, after the drawing was made, it was found that several new partitions had been put up.

52. There are no chimneys at all to the house. All the smoke escapes by the windows into the narrow lane at the back. The only light which penetrates into the basement is that which finds its way through at the cookhouse, and that which enters by the small area grating about 4 feet by 2 feet, in the street in front. Not only these Absence of chimneys. Inadequate lighting and ventilation.

basement or cellar dwellings, but also those on the ground and upper floors, are so dark, on account of the obstruction in the way of cabins and "cocklofts," that in making one's way through to the cookhouse much care is requisite to avoid falling over things.

Description of No. 22, Station Street. Cubic space.

53. Fig. 21, Sheet IV., shows No. 22, Station Street. The number of inhabitants is given in the drawing and the cubic space per head, exclusive of the cookhouse, which is separated from the main building by an alley, spanned by a narrow gangway. It seems almost impossible to conceive how so many inhabitants could be stowed away in so small a space. Indeed, some had come out into the street to do their work, namely picking oakum.

Description of No. 22, Market Street. Cubic space per head. Ventilation of lower storey.

54. Fig. 22, Sheet IV., gives the section of a somewhat less crowded building. In the upper storey 25 chair coolies lodged, having erected bunks to sleep on. Here the cubic space per head amounts to 400 on the upper floors. The lower storey was occupied by seven chairmakers, who used it as a workshop and dwelling. It should be noted that the only ventilation for the ground floor cookhouse is a hole 3 feet square in the floor above, so that the whole of the space, nearly 50 feet long, is lighted from one end only. In none of these buildings is there any such thing as a latrine.

Houses in lot No. 203 Taipingshan. Underground floors. Alley ways inadequate for ventilation and light.

55. Figs. 23–27, Sheet V., show the details of a block of buildings in the district of Taipingshan. It will be observed that there are two floors below the level of the ground on the one side. Also that the middle of the block derives its sole light and ventilation from a narrow central alley arched over at both ends.

The ground or basement floors which open off this alley are chiefly tenanted by hawkers of vegetables. They wash their wares in the alley, and, as the central channel is carelessly laid, the whole place is continually damp and offensive.

The dwellings of these unfortunates are quite dark. The drainage intended by the architect is shown in the section, a square channel running from cookhouse to cookhouse. Some of these dens were untenanted, so it may be supposed that even poor Chinese shrink from inhabiting such holes as these.

These buildings are recent.

Description of new buildings in Queen's Road.

56. Figs. 28, Sheet VI., and 29, Sheet VII., show the plan and section of a new block of buildings abutting on Queen's Road. Here again the ground and part of the first floor as seen from that street are below the level of the interior alley. In this case some improvement may be seen in the open space which ventilates the cookhouses of the double block of buildings facing Gough Street. In practice, however, such narrow openings are of little use, as they soon become blocked up with temporary erections.

Condition of block. Defective drainage.

57. This block is new and of decidedly superior construction, and on the whole well kept. The drainage, however, was remarkably defective; the drain from the central portion of the block passed down behind the retaining wall forming the back of one of the houses facing Queen's Road, and out under its floor to the main sewer. Being badly made, leaky, and untrapped, a most abominable nuisance ensued. This house was intended as an hotel for Europeans.

Alleys in the middle of property.

58. Figs. 26, Sheet V., and 28, Sheet VI., give a fair idea of the way in which access to the interior of large blocks by means of narrow alleys, the inadequate amount of light and ventilation which they afford to the surrounding buildings. Instances are to be found where the backs of two rows of buildings are separated by an alley about 4 or 5 feet wide, and where this narrow space has been divided up by boarded partitions. In one instance the alley thus obstructed, is public property.

Private lanes.

59. In some instances, chiefly on the level ground, near the harbour, two rows of houses face a central lane, which runs completely through the lot from street to street, and which is used as a thoroughfare. These lanes, as well as the narrow gulleys, are private property and not scavenged by Government. In blocks built on in this manner inaccessible gullies too often exist between the backs of the houses on one lot and of those on the next, as described in paragraph 43A.

Verandas over footpaths.

60. In Queen's Road and some other streets, permission has been given to construct verandas over the public sidewalks. These would afford agreeable shade to foot passengers. Being but narrow, and much obstructed either by persons looking into shops or by goods temporarily deposited, they are of but little advantage to the pedestrian, whilst the verandas above are so substantially built, and so enclosed with blinds, that they amount to inhabited spaces, and thus the width of the street is diminished by the depth of the veranda.

Lodging houses of labourers.

61. The lodging houses of common labourers are often very much crowded. In a row of eight small houses 428 inhabitants were found, having but 230 cubic feet of space per head, exclusive of the cookhouse. These houses were exceedingly filthy. They were built close to the scarp of the hill, from which they were separated by a narrow gulley only, which was wet and very dirty, and without proper drainage.

PART I.

Section 3.

Formation of Streets.—Side Channels.

62. As there were no wheeled vehicles till quite recently, a hard road surface was considered unnecessary, except to protect places liable to wash during heavy rains. Consequently the more level roads have been made with decomposed granite. This forms, in dry weather, a smooth and pleasant surface for pedestrians, but is incapable of resisting the wear and tear of the lightest wheeled vehicles. Even the "Jenrickshaws" cut it up. In the streets used by them, broken granite road metal is now being laid. Formation of street surface.

63. The streets running up the hill from the harbour are far too steep for carriages, and are much exposed to wash during heavy rains. To resist this some have been formed with lime concrete, which, when well made, is very durable under the traffic to which they are exposed. Others are paved with long granite blocks, laid transversely, each alternate block being raised above that next to it, in order to give a foothold. Sometimes the paving slabs form the cover stones of the drains beneath. The steepest streets are formed into flights of steps with sloping landings between having surfaces of decomposed granite or concrete. Formation of surface in streets having a steep incline.

64. The side channels or gutters are in the form of a flat segment of a circle of granite blocks, set in cement, or of concrete rendered with cement. Alongside the gutter for a width of about 3 feet the roadway is concreted. Gutters and side channels.

65. The footpaths are either paved with granite squares, or formed of concrete. The centre of the road is quite as much used by pedestrians as the side-walks, which are often obstructed by the stalls of hawkers, who pay a small rent to the owner of the adjacent house for the privilege of occupying public property. Footpaths.

PART I.

Section 4.

Public Drains or Sewers.

66. The public sewers appear to have been made, rather as drains to carry off storm water, than as sewers to remove from habitations the foul waters usually known as sewage. Neither their form nor their construction is that which is considered desirable for the latter purpose. They do not appear to have been made on any general plan, but rather to have been constructed from time to time as the necessity arose, and they seem to have been designed to convey the storm waters and perennial flow from the ravines above, and the surface water of the streets and houses, by the shortest and most direct line to the harbour, into which they discharge their contents through large openings in the wharf wall. The inverts of these outlets are at about the level of low water ordinary spring tides. They are not provided with tide-flaps. With few exceptions no attempt has been made to carry out the affluent below low-water mark, nor to select positions for outfalls where a strong tidal stream would remove it. Consequently deposit takes place at their mouths, and hence at low tide there is a most offensive smell along the whole harbour front. General plan of sewers, their form and construction.

67. Several of the large sewers are carried under private property apparently without any necessity; for example, the drain down Peel Street, which is apparently taken out of its natural course to run under church property and beneath the United Club House. That down Ladder Street passes under the dwellings on lots 71 and 48. That down Po-yan Street passes under the Shin-Ping Theatre, and that down Pound Lane, after running under a block of dwelling-houses, unites with it, and the joint stream flows beneath a block of private property as far as Lower Lascar Row. Many other instances will be seen by reference to the plan. The probable explanation of these eccentricities is, that the sewer was constructed along the bed of some natural water-course, which was afterwards filled in and built upon, the existence of the drain being forgotten. In some instances sewers have been constructed along private lanes, which have subsequently been closed and built upon. (Example, drain near harbour-master's office under lot 228; that under property of Peninsular and Oriental Company.) Public sewers running under private property.

68. Some of the more common forms of sewer are shown in Figs. 30–34, Sheet VIII., and 40–43, Sheet IX. Figs. 34, 35, 36, 37, Sheet VIII., show some improved forms recently adopted. In some short branches, square and half-barrel brick drains are used, but they are not common. There is no example of an earthenware pipe sewer; the reason given for not using them being, that they afford no facilities for opening and cleaning. Section of sewers.

Absence of deposit in upper parts of town. Deposit in lower parts.

69. Though the forms of the sewers are not those usually considered suitable for the conveyance of sewage or even slopwater, still, thanks to the very steep falls which they possess, those above Queen's Road are usually quite free from sediment. A considerable amount of sand and sludge is deposited in the more level portions of the sewers where they cross the low and flat district of Sheung-Wan from Queen's Road to the sea. Here the drains must be opened and cleaned annually or biennially.

Want of catch-pits to retain washings from hills above town.

70. During heavy rains, a large amount of sand and mud is brought down from the hill sides above the town, and deposited in the harbour at the mouth of the sewer. With the exception of a series of catch-pits at the head of the sewer which receives the waters of the Glenealy ravine, no adequate arrangements exist to prevent or mitigate this evil.

Manholes.

71. No manholes exist, and therefore when a sewer has to be examined, the street must be broken up.

Ventilation.

72. There are no special ventilating openings either inlet or outlet, nor does the necessity for ventilation appear to have been recognised. The drains which receive the waters of ravines above the town have open mouths at their upper ends or intakes, and so they are to some extent ventilated. Where the drain does not run up to the hill side there is no proper ventilation. For instance, the drain along Old Baily Street terminating in Caine Road. In one instance, that in Peel Street, the natural ventilation of the sewer has been prevented purposely by the construction of a trap at top. Thus the uprising sewer-gas has no means of escape except by untrapped house drains and gulley holes.

Street gulleys.

73. Some few gulley holes are trapped in the usual manner with water traps. More often they are closed with an iron flap, which too frequently will not shut on account of a stone getting under its lip, or because of the rusting of the pivots.

PART I.

Section 5.

Water Supply.

Extension of water supply decided on. Present available daily supply.

74. The necessity for an increased water supply being fully recognised, and the plans for obtaining it being under consideration, it is unnecessary to describe the existing works in detail. The quantity now available in dry weather cannot exceed, at the most liberal estimate, six gallons a head a day. This is but a paltry supply for a tropical city, but with the strictest economy and great equality of distribution, it might suffice for the bare wants of life, drinking and cooking.

Waste of water. Absence of regulations for its prevention.

75. One would reasonably anticipate that, the supply being so small, the most stringent regulations were enforced to prevent waste and misusage. Not so, however. There are no byelaws, either for regulating the construction of house services, with a view to prevent loss from leakage, or imposing penalties for wilful waste.

Number of house services.

76. There are about 1,877 house services in the town, a large proportion of which are to the houses of Europeans. No new house services are now permitted to be connected, on the plea of the insufficiency of the supply.

Intermittent supply.

77. To economise water, the Pok-fullam supply is distributed on the intermittent principle, conducted in a manner which subjects it in the highest degree, to all the well-known dangers and inconveniences appertaining to that system. The water from Wong-na-Chong dam is not actually turned off daily, but the pipes are so small that the supply is virtually intermittent, at the western extremity of the district which it supplies.

Supply from public street fountains or hydrants.

78. Those who have no services, must get water from the public street fountains (hydrants), at which the supply is also intermittent, either fetching it themselves or paying water-carriers to do so. The usual charge for this is one dollar ($1.00) for 60 to 100 pairs of buckets, or for from 600 to 1,000 gallons, according to the distance or height to which it is to be carried. In the early morning these water-carriers assemble with their buckets round the street fountains, and wait for the water to be turned on. When this happens a general scramble takes place. Outsiders have little chance with the professionals, and the supply is often shut off before all can get their turn. Those who go themselves to fetch water are usually poor people; if they do not succeed in filling their buckets, nothing remains for them, but to go and seek their day's supply a long way off, from the water-holes aud rivulets on the hill sides.

Want of ball valves and cisterns.

79. Few house services are provided with ball cocks; in many cases there is no proper cistern. An ordinary plug tap is left open at night, so that when the water is turned on such vessels as may be provided for it may be filled, when the tap may, or may not, be closed.

80. The water is turned on at 2 a.m. till about 5 a.m. At this early hour the detection of waste is most difficult. The whole town is served at once, and when this is finished the water is shut off at the service reservoir. Consequently the services in the lower parts of the town completely empty the main in the higher districts. Air enters through open or leaky services, to replace the escaping water, and thus there is great danger of foul gas, or even sewage being drawn into the mains along with it. In the event of fire also the pipes must be refilled before pressure can be obtained, an operation further delayed by the escape of water meanwhile by the open house services.

Time and manner of serving. Mains emptied causing danger of pollution and delay in case of fire.

81. Much water is drawn from shallow wells, which are often situated in the cook-houses close to the house drain. The accompanying table gives the analyses of the water from some of these wells. There can be no doubt but that in many cases much dangerous contamination exists.

Supply from surface wells.

ANALYSES of HONG KONG WATERS.

DESCRIPTION OF SAMPLE.	Date when drawn.	Smell when heated to 100° F.	Phosphoric Acid in Phosphates.	Parts per Million.		Grains per Gallon.				Degree of Hardness—Wanklyn's Scale.
				Free Ammonia.	Albumenoid Ammonia.	Chlorine in Chlorides.	Nitrogen in Nitrates.	Oxygen absorbed in four hours at 90° F.	Total Solid Matter dried at 212° F.	
A. Well at Idle Wild House -	12/8/81	Very faint	Trace	0·006	0·036	0·8	Not determined.	0·0140	4·0	1·2
B. „ „ „ -	11/2/82	None	„	0·008	0·028	0·8	0·052	0·0140	3·0	1·2
No. 1. Well in Yue Hing Lane (Island lot No. 48.)	3/1/82	Distinct	Traces	1·220	0·224	4·4	0·298	0·3640	25·0	10·0
„ 2. From sewer at Tannery Lane.	3/1/82	„	None	0·036	0·100	1·0	0·0314	0·0462	4·2	1·8
„ 3. Well at Jardine Bazaar, 11 and 13.	9/1/82	None	None	0·022	0·070	4·4	0·231	0·0350	15·7	6·0
„ 4. Well at Wanchai Road -	9/1/82	Faint	None	0·140	0·096	11·8	0·611	0·0420	50·7	15·6
„ 5. Well at Hollywell Road -	23/1/82	Distinct	Very heavy trace.	1·720	0·132	5·6	0·513	0·0630	25·3	8·4
„ 6. Well at 44, Temple Street, Tah-mah-ti.	27/1/82	None	Trace	0·026	0·084	27·4	0·750	0·0350	66·0	7·8
„ 7. Well at General Post Office	1/2/82	Distinct	„	0·024	0·076	6·5	0·582	0·0350	26·2	9·0
„ 8. Well at Chartered Bank -	1/2/82	Faint	None	0·020	0·048	35·0	0·254	0·0280	74·7	14·6
„ 9. Well in Ag Fuk Lane -	9/2/82	Distinct	Heavy traces.	0·628	0·124	9·7	0·421	0·0630	34·0	11·6
„ 10. Well in Chu Toong Lane -	9/2/82	Faint	Very heavy traces.	1·748	0·362	9·6	0·156	0·1820	34·9	10·4
„ 11. Well in Yu Yam Lane -	14/2/82	„	Heavy traces.	8·600	0·424	14·4	1·210	0·1330	59·6	16·0
„ 12. Well at 17, Upper Lascar Bow.	14/2/82	Very faint	„	0·160	0·068	11·2	0·874	0·0350	53·2	18·0
„ 13. Well at 20, Cleverly Street	1/3/82	Distinct	Traces	0·172	0·276	7·7	0·335	0·0840	25·0	6·4
„ 14. Well at 18, Cleverly Street	1/3/82	Faint	Heavy traces.	3·520	0·192	41·6	0·300	0·0770	92·2	6·6
„ 15. Well in Kwai Wa Lane -	4/3/82	„	„	1·400	0·088	1·9	0·060	0·0350	8·4	3·0
„ 16. Well at 19, Hellier Street	4/3/82	„	„	1·850	0·104	2·8	0·083	0·0420	10·6	3·8

NOTE.—All the samples were turbid, the majority of them being very much so. When the suspended matters had subsided in all the samples the supernatant water was clear and bright. Nos. 1, 4, 5, 7, 9, 10, 11, 12, 13, 14, and 15 contained nitrites, some of them only in traces, others in quantity, but in no case was the amount determined.

Laboratory, Government Civil Hospital,
Hong Kong, 25th March 1882.

(Signed) HUGH MCCALLUM,
Analyst.

82. From some of these wells water is publicly sold at the following rates:

Sale of water from private wells. Prices paid.

At Nos. 18 and 20, Cleverley Street, one dollar for 350 "tickets." The ticket is a slip of bamboo, given as a receipt for a pair of buckets, or about 10 gallons. The price therefore is at the rate of $0.28, or 12½*d.* per 1,000 gallons at the well's mouth, not including cost of carriage. At Kai-Wah-Lane No. 2, the price at the well's mouth is 250 tickets for $1.00 to regular customers, or 1*s.* 4*d.* per 1,000 gallons. Strange coolies pay 3 cash for a pair of buckets. Delivered in the house, the charge is 100 tickets for $1.00, or 3*s.* 9*d.* per 1,000 gallons. In Square Street there is a water depôt where water is collected in buckets from the hydrants. This is sold and delivered at the house for 10, 15, or 20 cash a pair of buckets, according to distance, height of house, &c. At West Point a water-carrier charges $0.30 a month to deliver a pair of buckets a day (3*s.* 9*d.* per 1,000 gallons). There are about 300 men who make their living by carrying water. In many Chinese families it is the duty of the cook to fetch the water. If he is too late to get it from the street fountain he must go to the hill side.

83. An uniform rate of 2 per cent. on the assessed annual rental is levied on all tenements in the city, whether they are provided with services or not. No extra charge is made for waterclosets, baths, gardens, or even fountains. The fortunate possessor of a house

Government water rate, inequality of its incidence.

service may enjoy all these luxuries free of extra cost, whilst his less favoured neighbour has to pay extra for fetching a scanty supply of water, perhaps brought from a source of doubtful purity.

Supply of shipping and military establishments.

84. The shipping is supplied by water boats from streams on the eastern and western extremities of the town. The military establishments have an independent supply.

PART I.

Section 6.

Scavenging.—Removal of Excreta and Rubbish.—Public Latrines, &c.

Hand removal of excreta.

85. As a general rule throughout Hong Kong, in accordance with time-honoured Chinese practice, human excreta are removed by hand, on what may be called the "pail" system. Neither deodorisation or disinfection of any kind is attempted.

Waterclosets used by Europeans only.

86. In many European houses waterclosets are used in connexion with the town drains, but they are for the use of Europeans only; the method just mentioned being used for the native servants.

Use of dry earth.

87. In some public buildings the use of dry earth, or more properly decomposed granite, has been partially introduced.

Public latrines for men. Domestic arrangement for women.

88. As in the Chinese cities of the mainland, the men of the working classes resort to public latrines. Only in the houses of the more wealthy is there any latrine accommodation for men. Women and children of all classes use pots, generally kept under their beds. In coolie houses where there are no women, there is frequently a total absence of any provision for this purpose.

Number of public latrines.

89. There are 25 public latrines in the city of Victoria, having in all 565 seats, the number in each varying from 2 to 51. These latrines are built and owned by private persons as a business speculation. Their construction and management is supervised by Government, who levy a tax of $80.60 per seat per annum. The latrine owner derives his profit (said to be very large) from the sale of the manure collected, and from fees of 1 or 2 cash paid by those using them, according as paper and a cigarette are furnished or not.

Position and construction of latrines.

90. These latrines are large buildings generally standing among or in close proximity to dwellings or shops. They contain a number of small open-topped compartments with a half-door in front. In each compartment is a sort of seat or rather platform under which is a wooden tub to receive the excreta. Stoneware jars also are provided to receive urine. Beyond this no attempt is made to separate the solid from fluid products. Some latrines have two storeys, notably that on the Praya, of 51 seats, to which between three and four thousand persons resort daily. In one, the seats are on the upper floor, sheet metal shoots leading down to tubs on the floor below, an objectionable arrangement, for there is no means of cleaning the shoots. On the whole the existing latrines are offensive and a nuisance, both as to position and construction, and they are so crowded as to render improvements as to maintenance very difficult.

Removal of night-soil from latrines.

91. The night-soil from these latrines is removed daily, in covered tubs, by the Government scavenging contractor to collecting junks, and in them it is conveyed to Lap-sap-Wan, a bay on the west of the town, where it is returned to the latrine proprietors, who receive it on board their junks, in which it is conveyed away to Canton or elsewhere. For this removal the proprietor pays the contractor at the rate of $80.03 per picul (1 picul = 133⅓ lbs.).

Duties of the Government scavenging contractor.

92. The scavenging contractor performs the following duties:—

He furnishes the necessary gangs of men for sweeping the streets daily, removing the rubbish collected with that in the public dust bins, nine in number.

He removes the night-soil and rubbish from the Government offices, the gaol, and public buildings.

He provides boats with crews, which come alongside the Praya at specified points, between the hours of 5 a.m. and 7 a.m. in summer and 5 a.m. and 8 a.m. in winter. In these boats he receives and removes to Lap-sap-Wan street sweepings, rubbish, and night-soil. The former is thrown on the beach, the latter transferred to junks as described.

Eleven of these boats are for the reception of night-soil, and 10 for rubbish.

In the night-soil boats he receives all night-soil which is brought from private houses as well as that which he brings from the Government buildings and from the public latrines. The latter, being the property of the latrine owners, is conveyed in separate tubs, the rest in bulk in the hold of the boat. House-to-house collection forms *no* part of his duty. The rubbish boats receive any rubbish that may be brought by private persons,

that collected in sweeping the streets or removed from the public dust-bins. The contractor receives no payment from Government for this. His emoluments are derived from the value of the manure collected by him, or brought to his boats, and from the small freight paid to him by the latrine proprietors for the conveyance of the products of their establishments.

Profit of scavenging contract.

93. The city of Victoria, therefore, pays nothing out of public funds for scavenging, the manurial value of the matter collected being more than equal to the cost of performing this office; nay more, such is the reputed value of the manure obtained that many tenders for this contract have been received in which the applicants offer to *pay* various sums up to $3,800 per annum for the contract.

Present contractor has no formal agreement.

94. The actual contractor for several years past, pending the settlement of the general question of sanitation, has had no formal contract. He has continued to perform the work on verbal agreement only, according to the regulations drawn up for the last actual contract.

The contract is probably profitable.

95. Notwithstanding the recorded opinion of the Surveyor General to the contrary, it appears reasonable to suppose that the contractor makes a handsome profit by his operations. Otherwise he would not continue to do the work, as he is in no way legally bound to do so. It seems quite impossible to form any real estimate of the profits of the contractor. There can be little doubt that he is largely interested in the general trade in manure. Later on the information which has been collected as to the use and value of night-soil as manure will be given.

House-to-house collection.

96. The house-to-house collection of night-soil takes place as follows:—

The contents of the house pots are removed daily, every second day, or twice a week, according to the means or taste of the inhabitants, by labourers who are paid by the occupants of the houses, excepting in a few rare cases which will be mentioned further on. In houses where there are women, females perform this office.

Night-soil coolies are paid by inhabitants, not by contractor.

97. It must be clearly understood that these night-soil coolies are *not* the employées of Government nor of the night-soil contractor. With the exception of certain police regulations as to the manner and times of working in the public streets, they are under no control whatever. With regard to private houses, European or Chinese, there is no regulation as to how often the removal shall be effected, no fixed scale of charges for doing so. This is entirely settled between the coolie and the person employing him (or her). This should be distinctly understood, as it is a point on which much misapprehension prevails, even amongst residents.

Rates charged for house-to-house collection.

98. The following are the rates usually paid for this service:—

	Per month.
Daily removal, European and wealthy Chinese houses, *per house* -	$0.50 to 1.00
Every second *day*, Chinese family houses, per family - -	0.30 to 0.40
Twice a week, second-class Chinese dwellings, per pot or family -	0.10 to 0.15

Pig wash.

99. Kitchen slops and vegetable refuse are often kept for the pigs. Sometimes the occupant, or one of the servants keeps a pig in the outskirts of the town. Sometimes a pig keeper fetches the pig wash, and in return for it, carrys away the dry rubbish and ashes.

Gardeners remove night-soil.

100. Sometimes on the outskirts of the town, notably on the extreme east, gardeners collect night-soil from house to house, sometimes giving the occupant a few vegetables or a fowl on feast days, in return for the manure and pig wash which they receive. The villagers come across from Kowloon, and take away a great quantity of urine.

Excreta have no value; all have to pay for removal.

101. With these relatively unimportant exceptions, it may safely be said that excreta have no direct value to the inhabitants of Victoria, and that in some way or another all have to pay for their removal. In this very important point the townsman differs from the villager, either in Hong Kong or on the mainland. The excreta have an *indirect* value by reducing the cost of sweeping, &c. to the community at large.

Argument in favour of this statement

102. In reference to a suggestion that the monopoly of night-soil should be given to a contractor, the Tung-Wa Hospital Committee objected that to do so would increase the cost of removal, the coolie who carried it away no longer being able to dispose of the manure, and that therefore he would charge more for his services. There is, however, evidence to show that no appreciable proportion of night-soil is disposed of by the collectors with profit to themselves. The limited amount of cultivation near the city is against such a supposition. The inspectors of nuisances having been posted on the roads leading from the town, reported that a few buckets only passed them. Again, the Government contractor derives part of his profit from the night-soil voluntarily brought to his boats. If a serious proportion went elsewhere he would be sure to complain,

more often than he does. Again, if he made any regular payments to the collectors for bringing it to him he would not fail to bring this expense forward in stating the cost of his work, and would know exactly the numbers so employed. Whereas, in reply to a question as to the probable number of persons employed in this manner, he stated that on "Moon Cake" festival he regaled some 500 people with cakes, and remarked that he thought that more had presented themselves than were really engaged in this trade.

Details of system of house-to-house collection.

103. The night-soil coolies commence work in the Chinese quarters about 1 a.m., and proceed to the European houses somewhat later. Each carries a pair of buckets, suspended from either end of a bamboo. The pots are brought out into the street and emptied into one bucket, and they are rinsed with a little water, which is carried in a third small bucket for that purpose; or in the other bucket. The first rinsings are added to the night-soil, the second are put back into the water bucket so as to avoid diluting the sewage. The water used for rinsing undoubtedly finds its way into the drains. Thus at the very outset one of the great advantages claimed for the bucket system, namely, the exclusion of human excreta from the sewers, is partially annulled when both buckets are full, the coolie takes them to the receiving junk where he empties and rinses them. Police regulations provide that the buckets shall be furnished with covers.

Estimate of number of house pots.

104. The following are the results of the examination of 100 houses in Taipingshan:—

Number of houses	100
,, ,, families	794
,, ,, pots used	642
,, ,, floors	226
,, ,, brothels	9
,, ,, houses having shops on the ground floor	41
Number of houses 1 storey high	14
,, ,, 2 ,, ,,	46
,, ,, 3 ,, ,,	40
	100
Number of houses where removal takes place daily	28
,, ,, ,, ,, every second day	49
,, ,, ,, ,, twice a week	23
	100

Probable manurial value of night-soil.

105. As the manurial value of the night-soil must enter into any calculations concerning as to the cost of its removal or disposal, it will be well to consider the Chinese methods of applying its application. To do so thoroughly, however, would be to write a treatise on Chinese agriculture.

Use of night-soil as manure.

106. The following are the leading facts that have been ascertained. It must be remembered that Hong Kong is somewhat differently situated to cities on the mainland, for there is but little cultivated ground in the immediate neighbourhood. Most of the manure is taken to Canton and far beyond it. Hence the cost of freight enters into the consideration of the value. Human excreta are highly prized by the Chinese farmer as manure. They are used, sometimes mixed with ashes or refuse, as a compost, but more often diluted with water as a liquid manure, according to the nature of the crop to which they are applied.

Urine and fæcal matter are used for distinct purposes, and have different money value.

107. Whatever may be the uses to which they are put, whatever be their relative value, there can be no doubt that the solid and liquid excreta are used for distinct purposes, and the greatest care is taken, both in Canton and the villages, to keep them separate. In Hong Kong the solid is most valuable. Urine does not pay for transport. The contractor will allow a boat to load with urine close to his collecting junk, but if he see any solid matter being shipped, he is not slow in making complaints to the inspectors of nuisances. Again he states, that the matter collected from house to house, being largely mixed with urine, is little more than half the value of that from the public latrines, where more complete separation takes place.*

Money value of night-soil fluctuates with season of year.

108. It is scarcely possible to ascertain the actual selling price of this manure. It varies considerably at different seasons of the year. The chief demand is from April to September, when it is used to manure the mulberry trees in the silk-producing districts above Canton.

* These statements of the relative value of the solids and fluids are at variance with the recorded opinion of English chemists. Our object, however, is not to reform Chinese agriculture, but to find the best existing market for the refuse of Hong Kong.

109. The contractor gives the following prices delivered in Canton :— Prices as given.
Manure from public latrines, $0.17 to $0.20 per picul=10*s.* 8½*d.* to 12*s.* 7*d.* per ton.
Manure from house-to-house collection, $0.10 to $0.12 per picul=6*s.* 3*d.* to 7*s.* 6*d.* per ton.

Dr. Kerr, of the London Mission Hospital in Canton, made some inquiries, and gives the price at $0.15 per picul=9*s.* 5*d.* per ton for this manure at Canton. This the same value was also given in Singapore.

110. The average daily amount removed is stated by the contractor to be— Amount removed daily.

From public latrines - - - -	100 piculs.
From house-to-house collection - - -	300 „
Total - -	400 „

To check these statements, the number of buckets emptied into the receiving junks were tallied and contents weighed on three successive days. The average quantity removed per diem, as thus determined, was found to be 541 piculs or 72,131 lbs. a day. Again, the sailings of the junks for Canton were noted for a fortnight with the nominal cargo in each. This gave 615 piculs as the daily average. On the whole, the agreement of these results is as near as can be expected. Taking 600 piculs as the daily amount removed, or 80,000 lbs., the quantity disposed of per man, woman, and child per day of *mixed excrement* is $\frac{80{,}000 \text{ lbs.} \times 16 \text{ ozs.}}{131{,}000}$ - - - - - 9·7 ozs.

Dr. Parkes gives as the *average* amount of a population, man, woman, and child - - - - - Solid 2½ oz.
Fluid 40
42·5 oz.

Now the majority of the population are grown men, whose average solid excrement is given by various authorities as ranging in weight from 3·5 ozs. to 7·0 ozs. and even reaching 14 ozs. In Coldbath-fields prison the average weight was 8·55 ozs. a day. A vegetable diet greatly increases the quantity, that of some Bengalee prisoners was 12 ozs. Since Chinese subsist principally on vegetables, and since much urine is obviously removed together with fæces, it seems certain that a considerable quantity of fæcal matter escapes collection.

PART II.

Defects of existing State of Sanitation and Suggestions of Remedial Measures.—Preliminary.—Examination of existing Health Condition.

111. Before discussing the defects of the present system, and the means of remedying them, I think it desirable to examine the available evidence as to the sanitary condition of the Chinese, and to see whether they are on the whole more or less healthy than other peoples, and to define in general the requirements of good sanitation which are now recognised as desirable and necessary, and to discuss the relative merits of some of the chief methods employed for obtaining them. Sanitary condition of Chinese. Preliminary.

112. Many experienced medical men who have practised in China have recorded the opinion that typhoid fever is almost unknown there. It would appear that some have concluded from this, that the filth and stenches with which the Chinese surround themselves are not only harmless, but even beneficial: that they have discovered the true art of living, and that they should be allowed to do in Hong Kong as they do in the city of Kowloon, and elsewhere, in their own country. Alleged absence of typhoid amongst Chinese.

113. It will therefore be well to examine the evidence on which these conclusions are based, and to see whether, according to the scanty statistics available, the Chinese are so healthy a race that it would be presumptuous for westerns to interfere with their time-honoured stinks. Examination of evidence as to these statements.

114. With regard to the absence of certain diseases, with due deference to the experienced men who attest this fact, it must be observed that their evidence is not quite complete. On the mainland no vital statistics are kept, and by far the greater majority die without consulting an. European physician. Even in Hong Kong the greater number of deaths are registered by Chinese doctors, who with very few exceptions (those trained in England), do not distinguish these diseases from others similar in their general characteristics. Other medical men, while admitting the rarity of true typhoid fever, assert that malignant fevers, apparently filth fevers, are but too common. Dr. Dudgeon, of Pekin, in his paper on the habits of the Chinese, records three severe epidemics of cholera in China between 1820 and 1863, so this form of filth disease is not unknown. Doubts as to exemption from certain diseases.

Violation of laws of health certainly produces disease.

115. Even assuming the absence of certain forms of disease, and a comparative immunity from epidemics, there is no ground for the assertion that the violation of the laws of health is not punished, in China as elsewhere, with a general lowering of vital condition, and not only by intermittent scourges of epidemic disease.

Immunity of Hong Kong from epidemics possibly due to the newness of the city.

116. It is stated that hitherto Hong Kong has escaped the epidemics which have afflicted other places in the neighbourhood. The settlement is but 40 years old, and the subsoil beneath the city may not yet be sufficiently saturated with filth to make it a hot-bed for disease and a breeding ground of filth poison. It is somewhat premature to assume that this happy immunity will always continue, for the process of saturation is slowly but surely going on, and if unchecked cannot fail to bring forth abundant fruit, in the form of misery and disease.

The recorded death-rate per thousand cannot absolutely be relied on.

117. Death-rates in such places as Hong Kong are at best but uncertain guides as to the state of health of a community, for it is almost impossible accurately to estimate the population to which the number of deaths apply. This is more particularly the case where, as in Hong Kong, there is so large a shifting population. The officially published death-rates of Chinese vary from 26 to 30 per 1,000, rates far too high to permit the assumption of a good state of public health.

Average age at death a more certain test. Average at Hong Kong compared with other places.

118. To check the death-rate, which might be too high on account of an under-estimate of the population, I ascertained the mean age at death of all Chinese who died at Hong Kong during 1881. This test has the advantage of being independent of the correct estimate of the population, or even of the total numbers of deaths, provided that the average of a sufficient number of instances be taken.

Table of average ages at death.

119. The following table gives the mean age at death in Hong Kong, compared with that found in certain other places:—

Name of Place.	Mean Age at Death of ALL who died, Men, Women, and Children.	Mean Age at Death of those who died over 20 years of age.		
		Men.	Women.	All.
Victoria, Hong Kong, in 1881	18·33	42·0	46·0	43·0
All England, 1840 - -	29·00	—	—	55·0
Croydon, 1878 - -	31·0	56·6	58·4	—
Exeter, in 1878 - -	—	56·7	62·2	—
Oxford, in 1878 - -	29·5	55·7	57·9	—
Christian Hakkar Community in Hong Kong, from 85 deaths recorded by the Pastor Dr. Lechler* - -	30·48	—	—	51·81
Christian Community at Lelong, Basel Mission† - -	45·64	—	—	55·5

* Most of the converts are adults, so total average age is high.

† The pastor observes that the mean age from his returns exceeds that of the remainder of the people, for most converts are elderly people. Moreover, the infant mortality is not represented, as many die unbaptised and therefore unrecorded by him, owing to the great extent of his district.

Observations on mean ages at death of Chinese compared with those of Europeans.

120. The first comparison, that of the mean age at death of the whole population, is possibly of no great value. The infant mortality of Hong Kong abnormal on account of the practice, which obtains amongst certain religious bodies, of collecting moribund infants from all quarters, for the purpose of giving them the advantage of baptism. The comparison in the second column of the ages of those who die over 20 years of age is sufficiently striking and is especially applicable to Hong Kong, where so large a proportion of the people are adults. It may be objected that the exodus of aged Chinese reduces the mean age at death. This is possibly the case to some extent, but if so, the death-rate per 1,000 will be correspondingly diminished by the same cause. In the case of the resident European population we have a striking illustration of the effect of the deportation of the aged and sick, their death-rate being but 13 per 1,000.

Conclusion.

121. I think that the foregoing facts clearly show that the health of the population is not so good as to make it presumptuous to attempt to reform time-honoured abuses; on the contrary: to my mind they prove that reform is urgently required.

Recommendation as to returns of mean ages at death.

122. It is most desirable that accurate vital statistics should be obtained. I would most strongly recommend that the Registrar General be directed to prepare returns of the mean ages at death for the whole Colony of the city of Victoria, both as a whole, and subdivided into its various districts: for the larger villages such as Yan-ma-tee, Sankiwan, and Aberdeen separately, and for the smaller villages collectively. If practicable also, the mortality of the boat population should be dealt with separately.

123. For the reasons given in paragraph 114, it seems to be impracticable to obtain accurate returns of the causes of death. The Colonial Surgeon has, however, to some extent classified the diseases returned in causes of death by the Chinese medical men. It seems probable that a conference with them, and the circulation of some instructions, translated into Chinese, would enable them broadly to distinguish the more characteristic zymotic diseases, from other complaints. This information, with the returns of the ages at death, would afford much valuable and reliable information as to the health condition of the people, and would enable the effects of sanitary improvement to be traced. Even if it prove impossible to discriminate the causes of death in every case, the imperfect return would not be without value, for the relative number of deaths from zymotic diseases to those from other recorded causes could be obtained.

Recommendation as to classification of diseases causing death. Instructions to be circulated to Chinese medical men.

PART II.

Section 1.

124. The sanitary requirements, the fulfilment of which comes principally within the province of the engineer, are—

1st. The provision of a sufficient supply of pure air and water to every inhabitant, also light.

2nd. As a consequence of the first, it is necessary that all organic refuse, solid and fluid, capable of putrefaction be removed from the dwellings, and from the city, before putrefaction commences. If these substances be allowed to collect within the dwelling, the products of their decomposition taint the air, and thus the first requirement remains unfulfilled.

3rd. As a consequence of the first and second proposition, after removal from the city, the said organic refuse must be disposed of in such a manner as to render it harmless, and prevent contamination to wells, or to the air near dwellings.

4th. It is necessary to prevent the moisture in the subsoil from rising to within a certain depth below the surface of the ground; or in other words, the level of the subsoil water must be kept below a certain depth. Experience shows that this depth should be never less than 3 feet. In tropical climates an even greater depth is desirable.

Statement of general sanitary requirements.

125. There are other sanitary requirements of equal importance, such as the regulation of food supply, prevention of contagion, and the disposal of the dead, but they belong, indirectly only to the province of the engineer.

Sanitary requirements which do not appertain to the engineer.

126. It is found that the decomposition of human excreta commences in warm English weather in about 12 hours after evacuation. At first the products are harmless, but they become dangerous in from 24 to 36 hours. In hot climates this action takes place sooner, and therefore we obtain, as a corollary to the second proposition, the principle that all such substances should be removed at least once in 24 hours.

Decomposition of filth commences in 12 hours, daily removal therefore necessary.

127. Provided that problems stated in paragraph 124 be solved completely and sufficiently, the choice of the methods for their solution becomes a question of expediency and expense only. For example, it is within the bounds of possibility to remove all refuse of all kinds, foul water as well as excreta, by hand in buckets, but what would be the amount of labour involved in this undertaking? At the lowest estimate, the liquid refuse and excreta may be taken as equal to the water supply, 6 gallons or 60 lbs. per head per day, say, in round figures, half a hundredweight. The population of Victoria is 130,000, so that 3,250 tons must be carried daily. In other words, the load of an able-bodied coolie being about 1 cwt., this would be about equivalent to every adult Chinaman making one trip daily with a pair of buckets to a distance of at least a mile, going and returning.

Means of fulfilling sanitary requirements a question of cost only.

128. I trust that I shall be able to show that the same result can be attained equally effectively by the use of drains, and that no danger to health need result from their use.

Equally satisfactory results to be obtained by drains.

129. The means best adapted to satisfy the requirements laid down in paragraph 124 will vary in detail even in principle in different lands, and indeed in different cities. The recommendations that will be made are based not on English practice only, but on experince gained in India and other tropical countries, and from the study of continental practice. I do not propose blindly to copy English models, but to adapt known and tried expedients to local circumstances, and to Chinese custom, avoiding the mistakes which have led to partial or complete failure, in Europe and elsewhere.

Methods of sanitation must differ according to local conditions.

130. The chief objections urged against use of underground drains, by the opponents of that system, is that they conduct foul and pernicious gases into dwellings, and that they disseminate and diffuse, from house to house, the poisons which produce certain diseases. Where underground drains and sewers are badly designed, and imperfectly constructed, where the system is not complete, both as to the arrangements within the

Objections to underground drains.

house, as well as in the street, the evils just described have undoubtedly occurred, though on the whole, in the majority of cases it may safely be asserted, that improvement of health, often very marked, has resulted from the execution of drainage works.

Special mechanism or systems not requisite.

131. Methods and appliances are known, and have stood the test of experience, whereby the danger in question may be wholly obviated. They are neither expensive nor complicated, and require little or no special mechanism, but only the skilful application of certain principles to the use of well-known and generally available materials and appliances, coupled with good workmanship.

General principles guiding construction of sewers.

132. The general principles guiding the construction of both house drains and sewers are: first, they must have such proportions and such fall or gradient as will produce a current in them sufficient to prevent the deposition of suspended matter. If the level of the outfall is too high to admit of a natural fall adequate to produce this velocity, then the sewage must either be conducted to some lower point which will admit of sufficient fall, from which it must be raised to the outfall by pumping, or "flushing" must be resorted to. This expedient depends upon the principle that the gradients or slope of the channels being the same, large volumes of fluid flow faster than small.* Permanent deposit may therefore in some cases be prevented by artificially augmenting the natural stream from time to time, thereby increasing the velocity, so as to sweep away sediment. This operation is known as flushing. The selection of the method to be employed in any given case must depend on circumstances.

Deposit in all cases to be prevented. Hand removal costly.

133. Whatever be the plan adopted, it is essential that no deposit requiring occasional hand removal, should take place in sewer or house drain, for if it does, the principles laid down in paragraph 124 are violated. The cost of hand-cleansing is great, and from a purely economical point of view, it will be cheaper to construct works so as to obviate any necessity for it.

Ventilation, disconnexion, and trapping.

134. Secondly, it is necessary that both sewers and drains be ventilated, so as to prevent accumulation of foul gas within them, and further, that house drains be so trapped and disconnected, that gas cannot enter the dwelling through them. Experience shows that it is practically impossible to confine sewer gas, even water traps cannot be relied on to prevent its passage, for the water which forms the obstruction frequently escapes, either by evaporation, or by some fragment of cloth forming a syphon, and thus emptying the trap. Indeed it has been proved that sewer gas will actually pass through the water in a trap, being absorbed at one side and given off at the other. Hence sewers require ventilating orifices, so that gas may more easily escape in the streets, where it is comparatively harmless, on account of excessive diffusion, than in the house, where, owing to confinement, it is positively dangerous. For the same reason the house drains require ventilation and disconnexion. For ventilation, an inlet as well as an outlet is required. Therefore, immediately on the house side of the trap, an opening to the air should be provided, whereby not only fresh air may enter, but also any gas which passes the trap may escape. The provision of a free opening to the air, on the house side of the trap, is called "disconnexion." In a complete and well-constructed system of drainage there will be little sewer gas. If the whole of the works, in the house as well as in the street, are properly made, so as absolutely to prevent deposit, the emanations from these various openings will be innocuous, if not imperceptible. As no accumulation takes place, all being removed before putrefaction commences, little effluvium will be evolved, and that of a harmless nature.

Importance of proper house drains. Their imperfection is the cause of objections to water carriage.

135. The importance of proper house drains is paramount. They are the first link in the chain without which the remainder is comparatively useless. The failures of drainage projects to realise the advantages expected from them, and the greater part of the objections raised against the system of water carriage, may be traced to the neglect of the internal drains and appliances within the house.

Failure of drainage projects may be traced to defective house drainage.

136. Municipal bodies, whilst they have constructed admirable street sewers, have shrunk from the expense and interference with private property which the improvement of house drains involves. They have been connected to the sewers as they were, or their construction has been left to the proprietor, directed only by the builder and the plumber, and having been badly designed and worse executed, deposit has taken place in them. The emanations from these putrid accumulations escape into the house, and the subsoil is polluted by infiltration from leaky pipes. The sewage, instead of coming out fresh from the house, oozes slowly through the drains, and enters the sewer in an already putrid condition. Therefore noxious and dangerous gases are given off in the

* This principle is not mathematically correct. Strictly speaking the velocity varies as the square root of the hydraulic mean depth which is the sectional area of the stream divided by the length, the border of the channel wetted. For the purpose of illustration, the statement is sufficiently accurate.

sewer, escaping by the ventilating orifices or returning through the untrapped drains to the dwelling.

Open channels.

137. Open channels instead of pipes have been advocated for house drains, because they cannot convey gas, and can be more easily freed from obstruction. Unfortunately they are rarely applicable. It is not possible to carry an open drain through a house, as will often be necessary; open channels like pipes, to produce a current, must have a certain fall, hence in level ground they must be inconveniently deep at one end. Their application, even if desirable for slop water, will be limited. By proper construction most, if not all, their advantages can be realised by the proper use of pipes, and at no greater cost. The conveyance of sewage, even when free from fæcal matter, by open channels by the side of the street, would hardly be satisfactory, unless there were an almost unlimited supply of water for its dilution, a condition rarely found, except perhaps in some Swiss town, having a glacier or a snow-capped mountain close at hand. The question of the admission or exclusion of the rainfall from the sewers depends chiefly on local circumstances. The principal argument for its admission is that downpours of rain clean the sewers. This is worthless; for, firstly, there should be no deposit, and if there were, some regular means should be contrived for its removal, and it should not be left to accumulate till rain falls, which may not happen for several months, especially in the tropics. The admission of rainfall greatly increases the difficulty of disposing of sewage by application to the land, for it augments the volume to be dealt with in an irregular manner, and at uncertain intervals, and the augmentation takes place at the times when it is most inconvenient, during wet weather when the land requires no moisture. With this question we have little or nothing to do.

Existing sewers may be made suitable by modification.

138. I hope to show that the existing sewers of Victoria may be improved so as to fit them for the conveyance of sewage, besides serving to carry the storm water to the harbour, as they do at present, and further, that the sewage, during dry weather, may be diverted from their lower extremities, and carried to some distant outfall, where it will be innocuous.

Objects of dry-earth system. It does not do away with necessity for drains.

139. I will now proceed to the general discussion of the dry-earth system, examining its general objects and effects, leaving its special application to Hong Kong to be treated under the head of scavenging. I propose to show that the dry-earth system does not affect a complete solution of the problem of sanitation, and that it does not obviate the necessity for drainage.

Information on dry-earth system.

140. Complete information on this subject will be found in the Minute of the Army Sanitation Committee, dated 19th October 1881, on the comparative advantages as regards health, cost, and convenience of the dry-earth and water-sewage systems for cleansing barracks and hospitals, and I shall freely quote from it such passages as seem applicable to the requirements of a city.

Principle of dry-earth system.

141. The dry-earth system is based on the fact that dry *humus* (garden soil), mixed with human excreta renders them inodorous, to some extent innocuous, enabling the mixture to be kept for considerable periods near habitations, without danger to health or causing a nuisance. In a previous minute on the same subject quoted by them, in the minute referred to, the Commissioners thus define a dry-earth latrine: "This com-
" prehends the introduction of special arrangements into latrines, including suitable
" vessels, and some mechanical contrivance by which a sufficiency of dry *humus* (garden
" soil)—not sand, which is of no use, nor clay or other tenacious material—is discharged
" over the excreta each time the latrine is used by each man."

The necessity for drainage is not done away with by use of dry-earth system.

142. After stating that no complaints have been made as regards health, as to either class of latrines (dry-earth and water), from which we may infer that the dry-earth system satisfactorily performs the work for which it is intended, they proceed to say: "But there are other considerations as to the use of dry-earth latrines which may affect
" the health of barracks and camps injuriously, and which require notice.

" The latrine matter of a barrack is about one part in 190 of the total putrescable
" refuse. Now it is clear that if the latrine matter alone is dealt with, and the other
" sewage matter of the population, including, of course, that of animals, is left to itself,
" serious disease may be the result.

" One advantage of the water conservancy is that it affords an oulet for the entire
" barrack sewage. This is not the case with dry-earth conservancy, and it follows that
" whichever system is adopted, the cost of draining the barracks must be incurred.
" Absence of drainage is the main cause of unhealthiness of Indian stations; but all, or
" nearly all, have dry-earth conservancy; and nevertheless all these stations, with incon-
" siderable exceptions, have suffered year after year from cholera and enteric fever. As
" a matter of fact, it would be safe to state that wherever in India there are dry-earth
" latrines these diseases show their presence; and yet this fact affords no argument

" against the dry-earth system; it only shows that the dry-earth system does not reach " the real disease causes at the stations. It has reduced or abolished nuisance, that " is all.

" It may by so doing have removed certain predisposing causes, but it has left the " more important as they were.

" It follows that whether dry-earth or water latrines are to be introduced, thorough " drainage of stations, camps, and their subsoils is absolutely necessary for health, and " that the cost of drainage must be the same whichever system be adopted."

Conclusion. Drainage in all cases necessary.

143. I will not follow the Sanitary Commissioners through their comparison of the relative cost of water-carriage and dry-earth conservancy, for it is hardly applicable to Hong Kong. I do *not* propose the immediate and complete introduction of water-carriage, but I wish, however, to show clearly what the dry-earth system effects, namely, that whilst it effectually abates the excrement nuisance, it solves only one part of the problem of sanitation, and by no means does away with the necessity for drainage. To remove slopwater, well-constructed drains are as necessary as to convey excreta, and the effects of stagnation deposit and leakage into the subsoil are nearly, if not quite, as pernicious as if they conveyed excreta. If properly made to introduce water-carriage the addition of certain appliances is required, only not alteration or re-construction.

Removal of subsoil water.

144. The employment of sewers to remove subsoil water involves certain risks. It must be remembered that where water can enter it can also escape. Hence the means provided for the entry of water into the sewers from the ground may, under certain circumstances, also serve as exits for sewage, and therefore the sewers may pollute rather than drain the subsoil.

Conclusion.

145. The local applications of these principles will be considered in detail when treating of house construction, drainage, and scavenging.

PART II.

Section 2.

House Construction and Drainage.

The defects of existing houses.

146. A moment's consideration of the examples of Chinese dwellings which I have given —examples not selected for badness but fairly representative—will show that overcrowding exists to a very serious extent, both as to the number of inhabitants within a given cubic space, and as to the provision of proper proportion of open space for light and ventilation, and for giving free access to the building. Other sanitary defects also are equally apparent. The type of house in Hong Kong is quite different to that in use on the neighbouring mainland, and I am certain that the lower-class population is more densely packed together in Hong Kong, and worse provided with appliances for cleanliness, than they are in Canton. In Hong Kong the average number of inhabitants per house is 16, whilst in Canton it does not exceed 9 or 10. In Canton, over the whole city, there is not, on an average, a complete upper storey. Second and third storeys are there unknown, whilst they may be said to be the rule in Hong Kong. In China also there is in the middle of each house a square space open to the sky (Tien-Tsing, " Heavenly well "), with a sunken floor, which serves for ventilation and many other purposes. In some cases this court is covered in, but I have generally observed that there is abundant provision for ventilation, on the north side of the house especially. In short, the demand for house-room in Hong Kong vastly exceeds the supply. Every available space is at once filled and the overwhelming population overflows the dwelling into the street. The cook cannot find room or light in the cookhouse to chop wood, so he comes out into the street to do so, much to the detriment of the side channel. Washing and other domestic operations are conducted on the sidewalk, which, but for the vigilance of the police would very soon be occupied by artizans and small dealers. Indeed in many cases the sidewalks are already occupied by huxters stalls.

Unoccupied lots.

147. With all this overcrowding, and consequent dirt and discomfort, it is strange to find that, on the east of the town particularly, there are several large lots unbuilt on, and it is surprising to learn that time has elapsed during which the lessees were bound to build on them according to their leases, and yet the penalty of forfeiture provided by law has not been enforced. It would be unreasonable to demand in Hong Kong, as much house and open space per inhabitant, as would be thought desirable in cities built on more favourable ground. Building sites are only obtained at great expense, by excavating and embanking. Still I think it reasonable that some limit should be set to overcrowding.

Suggestion as to arrangement of buildings.

148. As to the arrangement of the buildings on the ground. The construction of buildings on sites, partly excavated in the side of a hill, is most objectionable, for the

basement or lower storey is rendered damp, by the percolation of water from the hill above, and the production of malaria is the consequence. It is well known that buildings on such sites are exceedingly unhealthy, unless the most efficient means be adopted effectively to cut off the subsoil moisture from the floor of the house. In Victoria, not only are these precautions neglected, but the condition is aggravated by the use of the retaining wall of the ground above, as the back wall of the house, no space whatsoever being left. (See Figs. 9, 10, Sheet II., 17, Sheet III., 22, Sheet IV., 25, Sheet V., 29, Sheet VII., and paragraph 31.) The construction of buildings without a proper space between their rear wall and the ground behind should be absolutely prohibited.

Underground floors.

149. The absence of any lane or alley giving access to the backs of the houses, a defect but too common in Victoria, is a great impediment to improvement in sanitation. It is a principle, almost universally admitted, that drains should not pass under the houses, but where there are no back alleys this is impossible. The want of a backway to the house is an almost insuperable obstacle to the introduction of the dry-earth, or any other improved system of conservancy. For the effective application of such systems, the work of cleansing and removal must be done by persons employed and directed by some public authority. If left to private persons, neither regularity nor thoroughness can be ensured. In the absence of a back entrance, the Government employées must traverse the whole dwelling, an arrangement to which the Chinese not unnaturally object, for reasons that will be stated under the head of scavenging.

The want of back entrances to houses impedes proper sanitation.

150. In framing regulations as to open spaces, continuous back alleys should be insisted on wherever practicable, and in case of existing buildings, every effort should be made to introduce means of access to the back parts of them. The Chinese like to retain such alleys as private property, and to close them with gates at night. There will be no objection to this, especially if, following the general tenour of their own customs, the neighbours appoint some person to be responsible for order and cleanliness in the common alley. The obstruction of the alley by partitions of any sort should be absolutely prohibited in new houses. Further, to encourage the construction of alleys, a smaller proportion of space might be permitted, when in the form of a continuous lane communicating with the public street, than when it takes the form of an enclosed court.

Continuous back alleys should be insisted on; where they are provided the amount of open space may be diminished.

151. The following are the amounts of open space prescribed by authorities in England. The Metropolitan Buildings Act (18 and 19 Vict. c. 122, sect. 29), specifies that: "Every building used or intended to be used as a dwelling-house, unless all the "rooms can be lighted and ventilated from a street or alley adjoining, shall have in the "rear or on the side thereof, an open space exclusively belonging thereto, of the extent "at least of one hundred square feet."

English precedents as to amount of open space. Metropolitan Building Act.

152. The Model Byelaws issued by the Local Government Board for the use of sanitary authorities are more precise, and more exacting, in their demands. Local sanitary authorities frame their own regulations, subject always to the approval and sanction of the Local Government Board. The Model Byelaws are promulgated by that body for the guidance of sanitary authorities, and set forth the minimum provisions which will, under ordinary circumstances, be sanctioned. The Model Byelaws for a great number of municipal purposes have been prepared, and I would strongly recommend that the Colonial Government should be supplied with a complete set. I am well aware that they are not by any means literally applicable to Colonial requirements, but they cannot fail to afford many valuable suggestions.

Model byelaws of Local Government Board.

153. In Part IV., New Streets and Buildings, pp. 29–32, with regard to the sufficiency of space about buildings to secure a free circulation of air, paragraph 53 provides that in front of the house, along its whole frontage, there shall be an open space, free from walls or other obstructions more than 7 feet high, not less than 24 feet wide. In other words, from the front of the house to the boundary of the property on the opposite side of the road there must be a clear space of not less than 24 feet.

Space prescribed in model byelaws. Space in front of house.

154. Paragraph 54, with regard to the space in rear of dwellings, I quote literally:—

"Every person who shall erect a new domestic building shall provide in rear of such "building an open space inclusively belonging to such building, and of an aggregate "extent of not less than *one hundred and fifty square feet*, and free from any erection "thereon above the level of the ground, except a watercloset, earth-closet, or privy, and "an ashpit.

"He shall cause such open space to extend literally throughout the entire width of "such building, and he shall cause the distance across such open space from each part of "such building to the boundary of any lands or premises immediately opposite or "adjoining the site of such buildings, to be not less in any case than *ten feet*.

Model byelaws. Provision of open space in rear of buildings.

"If the height of such building be *fifteen feet* he shall cause such distance to be *fifteen feet at least.*

"If the height of such building be *twenty-five feet* he shall cause such distance to be *twenty feet* at least.

"If the height of the building be *thirty-five feet* or exceed *thirty-five feet*, he shall cause such distance to be *twenty-five feet* at least." * * * *

The remainder of the paragraph provides against subsequent obstruction of such space.

No similar regulations for the tropics are available.

155. I regret that I am unable to quote any similar regulations relating to Indian, tropical, or sub-tropical cities.

Requirements as to open space in Victoria ought not to be less than that quoted, but site prevents this.

156. It would seem reasonable to demand in a tropical city like Victoria, sheltered as it is during half the year from the direct influence of the prevailing wind, a still greater proportion of space than that thought desirable in England. The character of the site, however, prevents, I fear, the provision of so much space.

Tropical rules as to space.

157. I would suggest the following rules as applicable to local conditions; though they do not provide all that might be desired, they will be an improvement on existing conditions, whilst they will not unduly restrict the utilisation of space.

Space required in case of an enclosed court or yard.

158. (1.) In case of courts or spaces wholly enclosed by dwellings, and not being in the form of a continuous alley, the communication from the public street or from a private lane to them being through a covered passage, the *minimum* open space to be *one hundred and fifty square feet*, that it shall be equal to *one fifth* of the total roofed-over area for buildings not exceeding 24 feet in height and *one fourth* for buildings more than 24 feet high.

Space required in case of alleys.

159. (2.) In cases where the space takes the form of a continuous alley, at the back of a row of buildings, a smaller space may be permitted. The alley to have a minimum width of 4 feet for a house not exceeding 16 feet high.

If the house be more than 16 and less than 24 feet high, then 5 feet.

If more than 24 and less than 32, 6 feet.

Upwards of 32 feet, 7 feet.

Alleys to communicate with street.

160. (3.) The said alley must communicate with a public street or private lane by an opening which may be closed by a door or gate, but the communication must not be by a covered passage, otherwise the alley will be considered to be a completely enclosed space, and must have the dimensions laid down for these.

Case of re-construction of several buildings out of a row.

161. (4.) In case of re-construction of one or more buildings forming part of an existing row, where it may not be practicable to make the alley communicate with the street direct, some latitude may be allowed, in order to secure the benefits of back communication. If the alley be made continuous for a length of 50 feet or more (three houses), then it may be allowed to communicate with the street by a covered passage of suitable dimensions, provided that no other more direct exit is available.

Courts and alleys to be kept clear of obstructions.

162. (5.) The courts or alleys to be kept clear of all obstructions except a latrine and ashbin. In alleys there must be a free passage for sweeping and removal of rubbish.

Case of a scarp wall forming one side of an alley.

163. (6.) Where one side of the back alley is formed by a scarp- or retaining-wall, then the width of the alley may be diminished by the face-batter or slope of the wall, provided that the remaining width at bottom suffice to permit access for cleaning, and that the space measured from the top of the scarp or wall to the wall of the dwelling have the proper width due to the height of the house, measured from the lowest floor.

Surface of pavement of alley to be below that of floor of house.

164. (7.) The surface of the alley or court should be at least one foot below the lowest floor of the building. It must be properly paved or concreted, and provided with a surface channel for the removal of storm water, as well as any pipe that may be constructed for sewage.

Legal expression and definitions omitted for the sake of clearness.

165. In the above suggessions, for the sake of clearness and brevity, I have omitted all legal phraseology and definition. This may be added, when the general principle has been determined, the Model Byelaws referred to affording a most excellent example.

Amount of window-space.

166. As to window-space, I would suggest that every habitable room should have a clear window-space opening directly to the external air, the area of which shall be equal at least to one-tenth the floor area of the said room.

"Smoke holes" not objectionable where they do not replace other

167. I do not see much objection to the use of "smoke-holes," provided that they do not replace other more efficient means of lighting and ventilation. They afford a rude but effective means of ventilation. They are not in accordance with our habits, but the Chinese seem to like them; and I do not see that they are objectionable, provided they

are at least 4 feet square. If smoke-holes are not used, then proper chimneys must be provided. proper appliances.

168. In the paragraph 156, prescribing open space, the increment is made proportional to a somewhat smaller depth of storey (8 feet) than that usually given (10 feet). This is done because it seems preferable to encourage low rooms, with a proper amount of window-space in proportion to the floor area, rather than lofty rooms, which are almost sure to be subdivided by "cock-lofts," or temporary intermediate floors, whereby the window-space provided for one floor has to serve for two. "Cock-lofts" should be absolutely prohibited. Lower rooms with proper window-space are preferable to higher rooms afterwards subdivided with temporary floors or "cock-lofts."

169. The question of the amount of cubic space per inhabitant is one of sanitary police, rather than of construction. The following are the amounts recommended by several authorities. Cubic space per inhabitant, a question of sanitary police.

In the Model Byelaws No. III., Common lodging-houses, p. 6, Art. 2:— Space required for English common lodging-houses.

"Three hundred cubic feet is recommended as the proper standard of cubic space to secure for each person; but in many rooms it will be right to appoint a larger space, and this can only be determined on inspection of the particular room."

In No. XIII., "Houses let in lodgings," p. 11, 400 cubic feet is prescribed for each person above the age of 10 years in rooms *not* used exclusively as sleeping-rooms, and 300 feet when the room is used exclusively as a sleeping-room. Half the above amounts are prescribed for a child under 10 years of age, in each case respectively. Spaces for houses let as lodgings.

The French Police Regulations fix 14 m.c. or 494·2 cubic feet as the proper cubic space per head. Space required by French police regulations.

170. In Victoria I would suggest that 400 cubic feet might reasonably be taken as the minimum cubic space where the room is open, but this should be increased to 600 cubic feet when the room is divided into cabins, exclusive, in both cases, of the cookhouse. Considerable latitude must be given to the sanitary authority in each case, and any regulations of this kind must be introduced gradually to avoid the discomfort that would be caused by suddenly and simultaneously evicting large numbers of persons. Cubic space suggested for Hong Kong.

171. Earthen floors should be prohibited, all should at least be paved with tiles, bedded in concrete. Floors.

172. In framing regulations on these subjects, care must be taken to word them so that they may be made to include roofed-in spaces of all kinds, for there is little exaggeration in saying that no house space, however small or unpromising, will be left untenanted; rooms, nominally shops, will always be found to be the sleeping quarters of one or more persons. Regulations to include all roofed-over spaces.

173. The question of latrines must now be considered. The present houses do not as a rule contain one, and I do not see how they can be introduced without incurring danger. In the majority of houses the cookhouse is the only place where such a structure could be made, and the available room is scarcely sufficient to allow for the necessary space for ventilation, and a latrine, whatever be its construction, absolutely requires this. A single latrine for the inhabitants of a house comprising several families would not be in accordance with Chinese custom. Women, of the better classes at least, would continue to use pots; they distinctly object to places resorted to by others; this was emphatically stated by the Tung-Wa Hospital Committee. There is, however, an important exception to this rule in the case of the Hakkars. Latrines.

174. The men, as we have seen, use the public latrines; this affords great facilities for introducing good conservancy. I think, therefore, that their use should be encouraged; they should be improved and increased in number. Still further to apply the principle of providing for these wants outside the dwelling, it is most desirable that semi-private latrines should be encouraged, serving for the neighbours inhabiting a street, alley, or block. For instance, it might be practicable to construct a common latrine for the inhabitants of the blocks shown in Figs. 23, 27, and 28. Men resort to public latrines, the numbers of which should be increased.

175. Lastly, it is stated on good authority that the Hakkar women of the working classes *would* use a public latrine, provided that they were convinced that women alone were allowed to enter it, and that female attendants only were employed. It is true that this idea was scouted by the Tung-Wa Committee, but it was subsequently suggested by a Hakkar, and approved of by others present of that tribe. The plan therefore seems well worthy of trial. Public latrines for Hakkar women.

176. On the whole, I am of opinion that it would be premature to enforce the construction of latrines in existing houses, but they may be sanctioned, if desired, under strict regulations. In new buildings it would be well to set apart some space that could be used for this purpose. This subject will be further treated under the head of scavenging. Compulsory introduction of latrines into existing houses premature.

Application of sanitary rules to new and existing houses.

177. The application of any sanitary regulations that may be decided on to new or reconstructed houses will be easy, and may be effected without serious difficulty or hardship to the owners of property.

Improvements to existing houses.

178. The improvement of existing houses is far more difficult. If all were done that is desirable, the work would amount almost to complete reconstruction. To force landlords to expend large sums to remedy defects in design which were actually sanctioned when the plans were submitted to the Government officers for approval according to law, would be a great hardship. Still some of the more glaring defects must be remedied at once.

Sanitary authority to issue orders for improvements.

179. I would suggest that sanitary regulations should be published, and that the sanitary staff, the constitution of which will presently be described, should be empowered to order owners of property to make necessary alterations, such as the provision of additional window-space, the removal of obstructions from alleys and lanes, the pavement of these and the floors of houses, the improvement of drains, and that a law should be made by which the execution of these orders could be enforced by suitable penalties.

Improvement fund.

180. To effect larger improvements, which would involve the expenditure of a serious proportion of the year's rent, especially when it is a question of remedying defects in original construction, rather than those arising from neglect or misusage, the Government should, on the recommendation of the sanitary authority, carry out the necessary works themselves, paying for the work out of an improvement fund, set aside for the purpose, and recovering the expenditure by means of a rate on the property, repaying both principal and interest in, say, 30 years, at the end of which time it would cease. The work would be well and cheaply done, and the annual cost to the landlord would be insignificant. It is understood that the Government of Hong Kong have certain funds derived from the licenses of gambling houses, the expenditure of which is reserved for charitable purposes. Surely the improvement of the dwellings of the poor is a charitable undertaking?

Reconstruction of houses not capable of improvement.

181. In the case of some of the worst houses which are not capable of improvement, the best plan would be for the Government to purchase them, for which the law provides, and re-build and then sell them. With good management, the ultimate cost to the Colonial Treasury would be small, for additional accommodation might be given in the new houses, thereby increasing the selling value.

Model dwellings.

182. To demonstrate the advantages which may be derived from good construction, and to show that they may be secured without any considerable additional cost, it will be well to construct some model dwellings.

Roads and drains should be prepared before offering building lots for sale.

183. Before offering new building lots for sale, it is most desirable that the roads should be laid out and graded, and the drains constructed. By this, much trouble will be saved. For instance, on the east of the town the level of certain vacant building lots is so low, that if houses are built according to the existing level of the ground, there will be considerable difficulty in draining them. If the houses are erected first, the streets and drains must be made to suit the houses. If, on the other hand, the streets and drains are made first, with proper levels and gradients, the houses will naturally be built to these levels, and they can then be drained with ease.

House drainage.

184. I have left the consideration of one of the most important improvements to the last, namely, the re-drainage of the houses. This is so universally and emergently required that it should be undertaken at once, and special means will be required to effect it.

House drains should be constructed by Government.

185. The importance of the house drains and the danger incurred by neglect in their construction have been already pointed out. In England, with workmen to some extent familiar with the work, it has been found next to impossible to secure proper design and execution by leaving the work to private builders, no matter how complete be the regulations drawn up for their guidance.

The necessity for complete and accurate work is not recognised, much is badly done and has to be taken up again. The cost also is vastly greater than if the work be carried out on a large scale, by a central authority, who can, if desirable, employ competent and responsible contractors. The remarks as to the distribution of charges which have just been made as to general house improvements, apply equally to their drainage, but a still more simple solution of the question may be found.

Payment for re-drainage of houses.

186. Inasmuch as every house (with few exceptions) requires re-draining, and the beneficiaries by this operation are not the landlord, not even the occupant of the individual house alone, but the general public, who enjoy the improvement to the sanitary condition of the City therefrom resulting, it seems equitable therefore, as well as expedient, to pay for this work out of general funds. All additional cost of house accommodation must

ultimately be paid for by the people, indirectly by increase of the house rent, or directly by increased taxation. In this case the direct method seems preferable, for it secures the prompt and efficient remedy of a great defect. If the current revenue be inadequate to provide the sums that can be annually spent with economy, then a loan will be required, to be repaid out of the general revenue. This will be most equitable, for it will relieve the present population of some of the expense by transferring some part of it to their successors, who will, it is hoped, be also benefited by the work done.

Provision against interruption of work.

187. In any case a sufficient fund should be provided for carrying out each year's allotted task without risk of interruption on account of the low state of the Treasury, produced either by the revenue being less than estimated or by some unforeseen expenditure. The money should be provided for the work and reserved for it alone.

Evils arising from interruption of work.

188. In my connexion with India and the Colonies, I have had but too frequent experiences of the evils resulting from the neglect of this precaution. Works are sanctioned and arrangements made for executing them with expedition; something happens to the revenue and orders are received to stop. Workmen are dispersed, plant lies idle, materials are lost and deteriorate. Meanwhile no benefit is derived from the incomplete work.

Details of house drainage.

189. The general principles on which house drains should be constructed have already been laid down. The manner of applying these principles varies so much with the different forms of houses that no general plan can be prepared. In the Appendix plans are given showing the proposed methods of draining several typical forms of houses, and a copy of the regulations for house drains laid down in the Model Byelaws, already referred to, is also given, as a detailed explanation of the general rules.

The objects for which the plans are designed.

190. The primary object of the drainage plans is the removal of slopwater, they are also fitted for conveying away that portion of human excrement that, as will presently be shown, must almost infallibly find its way into them, and when an adequate water supply is forthcoming, and proper provisions have been made for the reception of their affluent, they will be capable of carrying the whole excreta, if that prove desirable. No single plan will be applicable to the varied conditions and forms of houses to be met with. The plans are intended to show the varied methods by which the requirements of proper drainage may be met with under different circumstances.

191. As to material and size, I would recommend glazed earthenware pipes for house drains, as being on the whole the cheapest and most effective material. Having visited the potteries at Shek-Wan, I am prepared to state, that with a little trouble, the pipes can be obtained thence, probably at a cheaper rate than from England. For the drainage of one or more houses, a diameter of 4 inches, with a slope of 1 in 30, is found in practice amply sufficient. This fall gives an adequate velocity to prevent deposit of silt, and by making the inlet of smaller diameter than the pipe, any object which can enter will pass through it. Experience shows that obstructions from such causes as pieces of rag, &c. do not take place in the straight part of the pipe, but at the bends and syphons. Referring to the plans given in the Appendix, it will be seen that special facilities for obtaining access at these points is provided, and from them also a rod may be pushed through the straight intervening lengths.

Increased facilities for disposal of rubbish will prevent obstruction of drain

192. By these precautions, and by providing increased facilities for getting rid of dry rubbish and vegetable refuse from the house, any serious danger of obstruction will be removed. The want of proper conveniences for disposing of house sweepings is the cause of many of the numerous obstructions of the house drain which now takes place.

Increasing size of drains does not diminish liability to obstruction.

193. The usual argument in favour of house drains of large diameter is, "make it large enough, so that it will not choke." A badly made drain, in which deposit takes place, will choke up sooner or later whatever its size, the large drain on the whole more rapidly than one of moderate dimensions, for in it the flow, being diffused over a greater surface, is more sluggish. Abundant instances are on record where nature has corrected the work of the builder. The large drain has gradually filled up with deposit till its sectional area is reduced to the exact size requisite to convey the stream passing through it.

PART II.

Section 3.

Street Formation, Side Channels, &c.

On this subject I have few remarks to make.

Concrete road surface suitable for streets.

194. The concrete as used seems a very suitable road material where there is no wheel traffic. Its chief fault is that it is rather slippery on steep inclines.

Method of laying concrete so as to facilitate repairs.

195. The execution of repairs is difficult, for the new concrete joins but indifferently with the old. This may be to some extent obviated by marking off the surface by means of grooves into rectangles about one foot square. When a repair to gas or water-pipes is necessary, one or more of these squares can be broken up and relaid. When the work is finished, the regular boundaries of the old and new work prevents its having a patchy appearance. The junction of the new with the old is facilitated, for the joints are vertical, or may be undercut, thus preventing separation of the two.

A hard surface reduces the silt which finds its way into the drains.

196. The provision of a hard surface for streets is most desirable, for it will greatly diminish the amount of silt and sand washed into the sewers during the rain. It does away with the necessity for catch-pits at the gulley-holes. These are a common source of nuisance on account of the organic matter deposited in them, along with the sand and mud washed from the road.

PART II.

Section 4.

Street Sewers.

Outfalls of present sewers cause a nuisance.

197. The outfalls of the present sewers are through the Praya wall into the harbour. Here the tidal current is weak at all times. No steps have been taken to carry out the sewage beyond and below low-water mark, or to reach the tidal current. The inverts of the sewer outlets are usually at, or near the level, of low-water ordinary springs. Hence on a warm still day, at low water, the stench along the Praya is most offensive. At low water also, the huge mouths of the sewer are uncovered, and exposed to the full force of the northerly winds, and at such times it is probable that the pressure of the wind forces the sewer gas up them, which makes its escape by gulley-holes, and no doubt also, by the untrapped house drains.

An outfall remote from the town is the remedy for this nuisance.

198. The complete remedy for the nuisance caused by the discharge of sewage in front of the Praya wall, is to construct an intercepting sewer, collecting the sewage, and conveying it to some distant point, where it may be discharged without causing inconvenience.

Land for irrigation does not exist. Sea outfall.

199. A glance at the map of the island, will show that, there is no suitable land for the utilisation or purification of sewage. This question, therefore, needs no discussion, and we may assume that the sea must receive the sewage.

Study of tidal currents.

200. The first step towards the solution of the problem of interception is the determination of the position of the outfall. To do this a careful study of the tidal currents of the harbour must be made. The direction of the currents at different states of the tide and different points must be carefully observed. Inasmuch as the tides differ greatly in their character, summer and winter, the day tide being the greatest in one instance, the night in the other, and as observations can only be made in the day time, it is absolutely necessary that sets of experiments be made at both seasons. Hence, it was impossible for me to obtain complete data during my stay in Hong Kong. I thought it desirable, however, to make some observations which might at least indicate the direction of future experiments. Thanks to Captain Carpenter, R.N., of H.M.'s survey-vessel "Magpie," who placed the able services of Lieutenant Frederick, R.N., at my disposal for the purpose, I was enabled to collect the data which are given in the Appendix.

Results of current observations.

201. The results of these experiments are briefly as follows :—

(1.) That no material benefit will ensue from the concentration of the sewage at outfalls, anywhere within the length of the town.

(2.) That towards the eastern extremity of the town there is but little hope of finding a satisfactory outlet.

(3.) The experiments, so far as they go, tend to show that the most desirable position for the outfall will be in Sulphur Channel, which divides Green Island from the main island. Objects put in at this point do not seem, at any state of the tide, to be carried immediately in front of the city.

The outfall sewer a minor improvement in comparison to others.

202. Until the position of the outfall is finally determined, it is premature to discuss the construction of an intercepting sewer. There are many other improvements in the general drainage system which can meanwhile be made, which will be on the whole more beneficial to the general health of the community. An intercepting sewer is but the last step in the process of filth removal. Unless provision be made for removal from the house and the street, it will be of little use. It will abate a local nuisance, that is all.*

Whole of sewage cannot be removed to outfall by gravitation only.

203. Owing to the level nature of the land close to the foreshore the whole of the sewage cannot be converted to any one outfall by gravitation. The fall is insufficient. Never-

* Witness Brighton.

theless, it is possible to intercept the sewage of by far the greater part of the town, that above Queen's Road, and carry it off by gravitation. That of the remaining portions of the town must, either be pumped into the intercepting sewer, or discharged into the harbour by improved outlets. Their effluent will be relatively small, so that not much nuisance will be caused by this arrangement.

The whole rainfall cannot be removed in intercepting sewer.

204. It is out of the question to attempt to make an intercepting sewer to carry off the whole of the rainfall; 14 inches have fallen in one day. To remove the quantity of water that then fell on Victoria and the slopes above it in 24 hours, would require a pipe at least 12 feet in diameter. The intercepting sewer, therefore, should be constructed to deal with the dry-weather flow or true sewage only, leaving storm water to find its way to the sea as at present.

Partial dilution by rain water unobjectionable. Arrangements for intercepting sewage.

205. As it does not seem expedient to utilize the sewage by irrigation, a certain amount of dilution by rainwater up to the capacity of the intercepting sewer is harmless. This permits the use of the present sewers to be continued for the conveyance of sewage as well as rainwater, some minor improvements only being required. Thus the expense of a complete duplicate system of sewers proper will be avoided. The dry-weather flow can be diverted at their lower end by means of a tumbling bay or low weir, constructed across them as shown in Figs. 45, 46, 47, 48, Sheet VI. The height of the weir must be so calculated as to turn aside the whole dry-weather flow. When the contents of the sewer is augmented by heavy rains it will over-top the weir, and the surplus will pass direct to the harbour. In this case the effluent will be so diluted as to be inoffensive.

Temporary interception of sewage to conduct it out below low-water mark, so as to abate special nuisance.

206. The arrangement of the diverting weir, just described, would serve to carry off the summer flow of a sewer through a small cast-iron pipe, which could be extended below low-water mark, an arrangement which might serve as a temporary, or partial means of abating the nuisance in the harbour. The effluent of several drains might easily be united and carried out below low-water mark by a single pipe. The generation of gas in the large sewers at their lower ends, from matter deposited there, would by this means be prevented.

Preparation of drains to receive sewage.

207. The upper portions of the existing sewers, those above Queen's Road, are, thanks to their great fall, rather than to their design and construction, almost wholly free from deposit. Nevertheless, it would be well to render their inverts watertight, and to accelerate the dry-weather flow through them, by concentrating it in a semicircular tile, laid on the invert. Concrete should be filled in on either side of it, the surface of which should be rendered with cement. This work could be executed in lengths, the flow being temporarily diverted by a trough. See Fig. 38, Sheet IX.

Manholes required.

208. Permanent manholes are much required. At present the street must be broken up whenever a sewer has to be entered for repairs or inspection. They should be provided at all junctions. As there is so little carriage traffic, they may, in most instances, be made direct over the sewer, thus saving the expense of side entrances.

Deposit in sewers in lower districts.

209. Much inconvenience and expense is caused, by the necessity for cleaning out periodically, the portions of the sewers where they cross the low district about Bonham Strand. The deposit in them is due to silt and sand, brought down from the ravines above the city. In one case, that of the large drain running near the Harbour-Master's office, the deposit which takes place therein, is mainly derived from a plot of waste ground in which its intake is situated, and which is used as a rubbish tip. This sewer should be extended above this ground, which should be levelled and laid out for building.

Construction of catchpits at heads of sewers.

210. To remedy the inconvenience caused by the deposition of silt in the sewers, they should be provided at their upper ends with catchpits, in which such substances would be deposited and from which they could be easily removed. These catchpits might be formed by constructing masonry dams across the ravines, and they could be so designed as to promote ventilation also, as will be presently described.

Ventilation of sewers. True cause of nuisance from ventilating openings to be found in imperfect house drains.

211. The question of the ventilation of sewers is now attracting great attention. Loud complaints are made of the stenches which proceed from the ventilating grating. The real cause of the nuisance may almost invariably be traced to imperfect house drainage, for recent town sewers have been constructed with great skill. The sewage, owing to deposit and stagnation in imperfect house drains, enters the sewers in a state of active putrefaction, and much gas of an offensive and dangerous character is evolved. This gas will escape somewhere. The construction of ventilating shafts is but a palliation, not a remedy, of the evil. They merely remove the nuisance a little farther off. Where the house drains as well as the sewers are thoroughly well constructed, complete removal takes place before putrefaction commences, and little or no gas is evolved. In Chapel Brampton, a village recently drained completely, houses as well as streets, there is no nuisance whatsoever from the ventilating openings. A visit to the

outfall soon showed the cause of this, everything reached it in a perfectly fresh condition.

Ventilation required.

212. Much time must elapse before the house drains of Victoria are brought to the necessary state of perfection. Steps to provide ventilation must therefore be taken, but it will be well to proceed tentatively and experimentally.

All sewers to be ventilated at their upper ends if possible.

213. In any case, it is obviously necessary that all main sewers should be carried back, up the slopes of the hill, well above the town, and there terminate in open mouths. Further, to promote a current of air, their intakes should be made in the form of vertical shafts constructed in the masonry of the dams, which are proposed to form the catchpits at the head of the sewers. Figs. 49–53, Sheet XII., show this arrangement. For complete ventilation also inlets at the lower extremities of the sewers near the Praya will be required. They must be so arranged as not to be closed by the rising tide. If the whole of the sewer-gas can be discharged above the level of the town, a most desirable result will have been attained, and it will be well to try the effect of this arrangement first.

Action of ventilating shafts is usually local. Possible exception to this in Hong Kong.

214. Experiments on the ventilation of sewers by means of shafts and furnaces, have shown that their action is confined almost entirely to the portions of the sewer in their immediate neighbourhood. These experiments have, however, been made on long and level sewers. Those of Victoria are short and very steep (nearly 500 feet rise in three-quarters of a mile). It seems reasonable to hope that there will be a sufficient upward current, to take all the gas to the top, and that the draught caused by the shaft will not wholly be supplied by air drawn in through gulley-holes in its immediate vicinity.

Arrangement for ventilation; should one ventilation at top be sufficient.

215. If this be not the case, it will be well to avoid the discharge of sewer-gas in the narrow streets, especially in a climate like that of Hong Kong, subject to long periods of hot, still, oppressive weather. The sewers must be divided into short lengths by means of flap-valves, preventing the upward movement of the air in them. Below each flap, a ventilating pipe must be provided, leading to an upright pipe carried up the side of some building and terminating high above its roof. After all, this will be but a partial cure of the evil, for it will be impossible to make these ventilators so high as to be above all the houses in the districts above.

True cure for sewer-gas nuisance is to prevent its formation.

216. I again repeat that the only real cure for the sewer-gas nuisance, is to prevent its formation, by securing immediate removal, to which end proper house drains are the first step. This is true whether fæcal matter be excluded from the sewers or not.

Drainage of flat portions of city. Use of flush tanks.

217. The flat portions of the city, namely, that between Queen's Road and the Praya, traversed by Bonham Strand, and that eastward of the military property, should be provided with pipe sewers of small diameter, arranged to receive sewage only. The available falls are small, and their outlets will be covered at high water. Artificial flushing should therefore be provided. For this purpose I would recommend the use of Field's flush tank. This contrivance consists of a syphon, by which the contents of a tank of any desired size may be discharged rapidly into the sewer, thus washing away any deposit. The tank is filled by a continuous dribble of water; when full, the syphon comes into action, and it is emptied automatically. The frequency of the flush merely depends on the size of the tank and the quantity of water entering it. It will not be necessary to use water from the waterworks for this purpose. The perennial flow of the Nullas will, in most cases, suffice. Indeed the sewage from higher districts may be used for this purpose.

Note on intercepting sewer. Cast-iron pipe recommended.

218. As to the intercepting sewer, I would merely remark that, assuming the Sulphur Channel as the outfall, a cast-iron pipe seems the most suitable means of conveying the sewage of the higher districts to that point by gravitation. Such a pipe will work under pressure and need not have a uniform gradient, by which much trouble and expense will be saved. If desired, I am prepared to submit plans for this, but it seems premature to do so till the outfall is fixed on.

PART II.

Section 5.

Water Supply.

New waterworks.

219. As the most serious sanitary defect of all, the miserably inadequate water supply, is about to be remedied by the construction of new works, calculated to afford abundance of water to all, little need be said on the subject of quantity.

With increased water supply prevention of waste is necessary.

220. I would, however, point out that if waste of water which now obtains be not prevented, by stringent regulations strictly enforced, all the streams of Hong Kong will not be able to satisfy the wants of the city.

House-to-house inspection requisite, and regulations as to tubes and fittings must be enforced.

221. The completion of the new works, and the introduction of an augmented supply must be preceded by a complete house-to-house inspection of services and fittings. Regulations must be drawn up and enforced, as to the pattern and quality of tubes, taps, and fittings to be employed. Notices must be served on owners of premises, where the fittings are defective, directing them to renew them by a certain date, on pain of summary discontinuance of the supply. Penalties must be provided for the punishment of wanton acts of waste, or infringements of the regulations. As the existing Waterworks Ordinance gives no powers of this sort, a new Ordinance will be required, somewhat on the lines of the English Waterworks Clauses Act.

On the introduction of additional water, a constant supply will be given.

222. It is to be presumed that the Government of Hong Kong propose to abandon the present barbarous and dangerous intermittent supply, and introduce the simple, convenient, and economical constant system. The dangers to health and the inconvenience in case of fire caused by the intermittent system are well known. They exist, as we have seen, in an aggravated form in Hong Kong.

With a constant supply waste is reduced to a minimum.

223. With a constant supply, waste may be reduced to a far lower amount than with the intermittent, and this without any vexatious restrictions as to the legitimate use of water. To this end it is principally necessary to exercise strict and careful surveillance over the nature and condition of taps and other house fittings. The defective condition of these is the principal cause of waste. The leakage in each case may seem small, but it goes on night and day, and takes place in so many instances, that the total loss is formidable. Wanton and careless waste, by leaving taps open, is far less serious than usually supposed. In fact, with a constant supply under good pressure, the mess and noise made by a tap left running is such that someone closes it in self defence. It is not difficult, also, to select positions for taps, such that they cannot be left open without proving an intolerable nuisance.

Inspection required to maintain fittings Gratis execution of minor repairs recommended.

224. Suitable fittings must be used, and to ensure their being kept in repair, continual careful inspection is requisite. I strongly recommend Government to execute certain minor repairs gratis. It pays in the end. The most important of these is the repair of the draw-off taps. In the pattern usually employed for high pressures, a disc of leather is pressed down on the orifice through which the water escapes, thereby closing it. In the ordinary course of events the leather wears out, and the tap leaks. The turncock, or district inspector, should renew the leather at once, an operation which takes but a few minutes. In practice he carries several spare taps with him, and he takes off the defective and replaces it with a perfect one. The faulty tap is then taken to the store and re-leathered, cleaned, and given out again. The cost of this is trivial, and the effect on the waste very great; a private plumber would charge a considerable sum for this work, and there would be much waste of time, during which loss of water goes on. By such simple means as this it is possible to keep down the consumption of water to a very low amount indeed. I know of several small towns where it does not exceed from 10 to 15 gallons a head a day, yet there is no restriction on the use of water whatsoever.

House services should be encouraged and standpipes in the streets abolished, as causing waste and disorder.

225. I should also recommend that public standposts (known as "hydrants" in Hong Kong, a term usually applied to firecocks), should be abolished as soon as possible. Less waste takes place with well-managed house services than with public standposts, which are no one's property, and which no one looks after. They are always a nuisance, making a great mess in the street, and the assembled water-carriers cause noise and obstruction.

The Government should lay on house services at cost price.

226. On the introduction of new supply, no pains should be spared to promote the introduction of house services. Water should be laid on to every house, or at least to every court or alley. To ensure the use of proper materials and workmanship the Government should lay on services themselves. They will be able to do this far cheaper than the private plumber (I speak from personal experience), and the work will be well done. Further, to encourage services they might be done for deferred payments, or even for an annual rental.

Wrought-iron pipes preferable to lead.

227. In almost every respect, wrought-iron piping is preferable to lead for house services. In the first place, it is cheaper both as to prime cost and labour of fitting. Plumbers are not required. An ordinary intelligent labourer can soon learn to screw together wrought-iron pipes. The same men that excavate the trench can lay the pipe and complete the service, the connexion to the main being made by the turncock. (This has been done with Russian labourers.) In the second place, wrought iron resists hydraulic shocks better than lead; and lastly, it does not contaminate the water.

Quality of wrought-iron pipes, their protection from corrosion.

228. The quality of wrought-iron pipe known as "best steam" not "gas," should be used, and it should be coated with Dr. Angus Smith's composition. In salt ground this may not sufficiently protect the pipe, which in such cases should be laid in a little V-shaped trough of boards, filled with a concrete of tar and sand.

System of water rates.

229. The existing system of water rates appears to be unjust. The uniform rate over all property should be allowed to remain, to encourage the laying on of house services, but it should be largely reduced. It is justifiable on the ground that all may have water (which it is to be hoped will soon be the case), and that all derive indirect benefit from the waterworks in the shape of protection from fire, &c.

Extra rates for baths, closets, &c. Use of meters recommended. Scale of meter rates.

230. Special extra rates for baths (fixed) and waterclosets, should be provided, in short, for all extensions beyond a simple draw-off tap. By far the most simple means of doing this, is to charge by meter, for the water actually consumed. Indeed, but for the great cost of the meters, I would recommend their universal use. To all houses having more than a simple tap, meters should be fixed. This saves all trouble about inspecting fittings, and leaves the proprietor quite free to waste water or use it as he likes, but he has to pay for what he uses or loses. A scale of charges for water by meter would be required. I would recommend the Manchester Corporation scale of rates as a model for this work.

Improvements to existing system pending completion of new works.

231. As several years must elapse before the new water supply can be introduced, it will be well to take some steps to remedy the glaring defects of the present system of distribution. In the first place, the whole city must no longer be served at once by turning on the water from the reservoir. The town should be divided into districts, or parallel zones, of about equal altitude. The water should be turned on to each district in succession for a stated time daily, so that all may get their fair share of water. The present mains are all connected to house services, which prevents (so I learn at least), the adoption of this plan.

New mains required for distribution of new supply.

232. New mains will be required for the complete distribution of the water supply. Some of these should be laid at once so as to facilitate the proposed system. I cannot give the precise arrangement, which must depend on the point at which it is proposed to deliver the new supply, but the following is the general principle which should govern the design.

Arrangements of new mains for immediate improvement of intermittent supply.

233. From No. 2 tank, or from the point of delivery, wherever it may be, a principal main should be laid east and west along the highest part of the town. From this secondary mains should be carried down through the town to the Praya, and to these all the existing mains should be connected right and left, with stopcocks at their junctions, so that each branch is commanded separately. Further, the branches should be subdivided by stopcocks, so that each portion supplies a zone or district of nearly equal altitude. No services should be connected either to the principal or to the secondary main, but they should be liberally provided with fire-hydrants. The principal and secondary mains should always remain charged. If properly jointed, there will be no waste from them. Thus, in case of fire, water will be instantly obtained from the hydrants on them, at full pressure, and but a few minutes will elapse before one or more of the branches can be charged and the water brought to bear on the fire. In "serving," the water should be turned on successively, to each district or zone, and kept on for a definite length of time, depending on the size of the district, and its altitude above the sea. The proper hours of "serving" must be determined by experiment, and should be published from time to time.

Compulsory provision of ball-cocks, or as an alternative supply by meter.

234. A byelaw should be made that each consumer must either provide a cistern and a ball valve, the latter to be supplied and fixed by Government, or take water by meter. The latter would, in the case of European houses, be by far the most satisfactory arrangement to all parties. The meter should be provided and fixed by Government, and a rent charged for its use. Those taking water by meter would be partly or wholly relieved from the general water rate. Care must be taken to select the best type of meter.

New and enlarged main from Wong-na-Chong stream required.

235. A new main of larger dimensions should be laid to distribute the supply at present derived from the Wong-na-Chong stream. Even if this source of supply be abandoned on the completion of the new works (I see no reason for doing so), the new main will be required to supply the eastern district.

Utility of Wong-na-Chong waters for other purposes than domestic supply. Water right should be retained by Government.

236. Even should the Wong-na-Chong stream be abandoned as a source of supply for domestic purposes, the Government should on no account part with their right to its waters, which will be of infinite use for flushing sewers, or even for supplying some part of the motive power required for pumping sewage from the lower districts. This applies also to the waters of the other nullas.

Defective condition of principal service reservoir.

237. I am credibly informed that the large reservoir No. 2 cannot be filled more than half full. I was unable to obtain any reliable information as to the cause. I merely place the defect on record, so that it may be investigated and remedied.

238. By adopting the measures I have described, the efficiency of the present supply may be vastly increased. A new Ordinance will be required to give the necessary powers. As the condition of things for some time to come will be provisional only, it will be well to frame the Ordinance in general terms, empowering the Governor in Council to make byelaws from time to time as may be required.

The efficiency of the present supply may be increased. New Ordinance required.

239. The introduction of sand-filters, both to the new and old waterworks, is most desirable. During the dry season the water is beautifully clear, but I am informed that during the rains the water is turbid, a fact fully demonstrated by the deposit found in the pipes. Even in the dry season the water would be much improved by filtration. In a waterworks which I recently constructed, I was surprised to find what a quantity of organic matter and miscellaneous impurity was removed by filtration from a water, at least as clear in appearance, as that of Hong Kong. Though filtration has no appreciable chemical action on the substances in solution in water, still by removing suspended matter it is more than probable that a most important improvement is effected. The experiments of Pasteur and others show that disease germs may be removed, both from air and water, by simple mechanical filtration.

Desirability of filtration, importance of same.

PART II.

Section 6.

Scavenging.—Removal of Excreta.

240. The defects of the present system of night-soil removal are: *First*, that it is done irregularly and unsystematically, and in many cases at too long intervals (twice a week). Inasmuch as the pots are often kept in dwelling-rooms, daily removal is of the greatest importance. *Secondly*, much finds its way into the drains, the greater part of the urine, the washings of pots, and sometimes, indeed, the whole contents of buckets, being thus disposed of. *Thirdly*, the practice of emptying and washing the foul house-pots in the street is in itself a nuisance.

Defects of present system of night-soil removal.

241. The general limits of utility of the dry-earth system have been already defined, namely, that it abates the excrement nuisance, but does not in any way abolish the necessity for drains to carry off the remaining sewage, which is but little diminished in quantity or noxiousness by the exclusion of excreta.

Limits of utility of dry-earth system.

242. It must now be considered in its special relations to Hong Kong. It has been shown that a supply of *humus* (garden soil) is necessary for efficiency. As to the actual quantity of *humus* required, very scanty practical data are forthcoming. I believe that 5 lbs. per head per day, man, woman, and child, is a most moderate allowance, so small indeed that with it efficiency can only be guaranteed on the assumption that the principal amount of the fluid excrement is not treated.*

Application of dry-earth system to Hong Kong.

Now for a population of 130,000, that of Victoria, we should require annually 105,853 tons of dry earth to be brought in and distributed, and about 127,020 tons of mixture would have to be collected and removed. To calculate the quantity of land requisite to afford the necessary humus, we may assume that a cubic foot of humus measured "in situ" would give about $\frac{3}{4}$ cwt. of dry earth, and that there is 6 inches of humus on the land. The area required to afford the necessary amount of humus would for one year be 129 acres of land. At least an equal area of land would be required to purify the product and fit it again for use. Lastly, huge depôts would be required to store up the dry earth, for use during the wet season. These considerations alone suffice to show that the difficulty of procuring dry earth is sufficient to prevent the application of the system to a city like Victoria.

243. There are further difficulties in the way of the domestic application. Either a self-acting closet must be provided, whereby a proper quantity of earth is applied

Difficulties in domestic application.

* The patentees say that 1½ lbs. is required each time the closet is used. The Army Sanitary Committee give the following data derived from actual practice:—

"If small cylindrical pans be used, the quantity of '*humus*' required is about 2½ to 3 lbs. for every use of the closet per man; but the larger the surface exposed in the vessel, the greater must be the amount of earth, and to ensure the best possible result, provision should be made for receiving and dealing with the urine separately. Latrines for women require more earth than those for men."

"If all the urine of a barrack were treated by the dry-earth system, a much larger quantity, about 8 lbs. per man per diem, would appear to be required; according to Indian experience, 1 gallon of urine would be taken up by 36 lbs. of earth." In a report to the Local Government Board concerning certain means of preventing excrement nuisance, dated 1875, it is stated, in reference to Lancaster, that for 120 latrines serving about 500 people, the quantity of dry earth used weekly amounts to 22 loads, each load weighing from 23 to 24 cwts. This is equal to 16·5 lbs. per head per day. These facts fully justify the assumption of 5 lbs. as the minimum quantity.

automatically at each time of use. The expense of these is considerable, 5*l.* to 5*l.* 10*s.* per seat (apparatus only). Or they must be visited daily or oftener, by a public employée who throws on the earth. Neither of these conditions can be fulfilled in the houses as at present constructed. Then, the objection to the use of common latrines by Chinese women must be remembered. Nor does it seem desirable to permit accumulation of excreta in or about tropical dwellings, even when deodorized (not necessarily disinfected) by earth.*

Dry earth best suited for public latrines.

244. No town of any size has been able to introduce the dry-earth system completely. It seems most applicable to public latrines where a person can be constantly employed to apply the earth.

Dry-earth system not a Chinese custom.

245. I have not been able to find out that the application of dry earth to the deodorization of excreta is in any way a Chinese practice, and the assertion that it is a time-honoured Chinese custom appears to be based on an entire misconception. In Canton, *sand*, not garden mould, is sprinkled under the seats of the latrines, to facilitate the gathering up of the fæces, but the smallest possible quantity of sand is used, so as to avoid contaminating valuable manure with inert matter. Outside farmhouses are latrines, in which wood ashes are kept, and on them the excreta are allowed to fall for the same purpose. The idea of disinfection or deodorization is quite foreign to the Chinese mind.

Night-soil is applied in a liquified condition. Animal manure is dried.

246. I further learn that human manure is usually applied in a fluid state, diluted with water. Dr. Kerr, of Canton, made some inquiries for me, and learned that it is not dried and used as "poudrette." *Animal* manure appears to be so treated.

Dry-earth manure of so little value as not to be worth transporting.

247. It has been shown that the manurial value is a most potent agent for ensuring the removal of excreta. If it be diluted with several times its weight of inert earth, it will no longer be worth transporting to Canton. Not only will the value of the manure be lost, but great expense will be incurred to secure its proper disposal. The absence of suitable land renders this difficulty almost insurmountable.

Methods of hand-removal cannot be carried out completely. Water-carriage system preferable to all others. Use of European water-closets not necessary.

248. The more I consider the various methods of hand-removal, the greater difficulty do I find in devising means for carrying them out practically and completely, so as to realise the advantages which their respective advocates claim for them. It has been shown that good drains are a necessity in any case for the removal of slopwater, which forms about four-fifths of the total sewage, and it seems, therefore, obvious that the simple, cleanly, and efficient water-carriage system is vastly preferable to all others, provided that conditions proper for its introduction exist, namely, a supply of water, good house drains and sewers, and a proper outfall. Moreover, all these things are equally necessary whatever be the method of removal adopted for excreta. It must be clearly understood, however, that in advocating the system of *water-carriage*, I do *not* advocate the use of the ordinary *watercloset* (mahogany seat and brass handle). Arrangements suitable for local requirement may be devised.

Introduction of fæcal matter into present drains impossible. Hand-removal must continue.

249. Considerable time must elapse before all is ready for the abolition of the hand-removal system, for it would be madness to encourage the introduction of excreta into the present house drains. Some improvement of the present system must be devised. It seems probable, also, that on account of the manurial value of night-soil, it may always to some extent be collected by hand.†

Dry-earth system being inapplicable, house-bucket or pail system must be resorted to.

250. On the whole, it appears that the dry-earth is unsuitable for general application, and therefore the house-bucket system must be resorted to, its existing defects being remedied as far as possible.

Difficulty caused by the absence of latrines, and by certain customs of the Chinese. Objection to entry of Government employées.

251. At first sight it appeared that it would be possible to devise a system whereby the pots could be removed, covered and undisturbed as to their contents, to some depôt where they could be emptied, washed, and stored, clean vessels having been left in the place of those removed. It was found that the vast number of vessels to be moved would be an almost insuperable obstacle to this plan. There are often six or more in one house, say about 30,000, to be handled daily. Again, with reference to a suggestion to limit the number of vessels in use to one per house, on consultation with the Chinese it appeared that they would have the strongest possible objection to use such vessels in common with others. In fact, to do so would be a violation of their domestic customs. Further, they object to the house-to-house collection being made by Government employées, for, as they say, not being paid by the occupant of the house, they would be

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* . . . . "In the climate of India the latrine contents under the dry-earth system abound in 'Vibriones,' a test of the presence of disease putrefaction"—Army Sanitary Commission, page 5.

† In the case of public institutions, especially hospitals, no pains or expense should be spared, to introduce water-carriage, thoroughly and completely, as soon as possible. For hospitals, the immediate removals, which can alone be effected by the water-carriage system, is of the highest importance.

practically independent of him, and he would therefore have no easy means of punishing insolence or neglect,—an important consideration, considering that these persons have to penetrate into the most intimate parts of the house. This is another instance of the inconvenience of having no latrines, and no separate means of access to the back parts of the house. After due consideration of the suggestions and objections of the Chinese, which they have expressed from time to time, I venture to believe that the following plan would effect an improvement.

Manurial value. Monopoly of contractor.

252. The value of the manure obtained is the most potent agency to secure its complete collection. Though the contractor has no legal contract or monopoly (see paragraph 94), yet it seems probable that he and his associates have a practical monopoly. He knows and probably fees the coolies who collect. If one does not turn up at the proper hour, he or the foreman make a disturbance.

The work of night soil collection should be separated from street sweeping, to ascertain true value and cost.

253. The night-soil from house-to-house collection is now given to the contractor, as payment of the work of street sweeping and general scavenging. There is therefore no means of ascertaining the value of the manure or the cost of the work done. I would suggest that these two functions should for the future be dissociated and each tendered for separately, especially as the scavenging also requires improvement.

Division of town into districts. Competitive tender for removal in the district.

254. To promote competition and encourage careful control, I propose that the town should be divided into districts. The monopoly and property of *all* night-soil in each district should be allotted periodically to a contractor. These contractors being relieved of the expense of scavenging, it is to be anticipated that a handsome sum would be jointly paid by them for their monopoly, which would go far towards the cost of improved sweeping and scavenging.

The *whole* night-soil of each district to be the monopoly of contractor for that district. Collectors still paid by occupants of houses.

255. The night-soil of any given district would be the sole and entire property of the contractor. The night-soil coolies would be bound to bring all they collect to his boats. He would also have the product of the public latrines which I propose should be acquired by Government. The collecting coolie would still be paid, or part paid, by the inhabitants, so that they would retain some control over them.

Contractors to provide boats. Government should provide suitable boats in the first instance.

256. The night-soil contractors must provide boats of approved construction at proper places and times. I would recommend that at first the Government should themselves make proper barges for this purpose, and also for rubbish and sweepings, for the common cargo boats now employed leave much to desire.

Use of a steam-tug recommended.

257. I would also recommend the Government to provide the use of a steam-launch to tow these barges to and from their stations to the depôt or rendezvous at Lap-sap-wan. This would prevent much delay, especially during strong northerly winds, and there would be no reason for these barges to be hanging about among the shipping with their unsavoury cargoes. Lastly, the use of a steam-tug would allow the place of rendezvous with the receiving junks to be removed to some more distant spot.

District contractor to cleanse latrine He would supervise collecting coolies.

258. The duty of cleansing the public latrines and those of the public buildings would rest with the contractor for the district in which they are situated. He would also, for his own interest, know and control the working of the night-soil collectors, and would see that they did not make away with his property and also that they collected it daily, and thus improvement may be hoped for in the first two points of defect.

Removal of nuisance from washing pots; difficulty of providing depôts for this.

259. The third question, that of washing the house pots, remains to be considered. It is an evil inherent to hand-collection for which it is not easy to find a remedy. If the police insist that the pots be no longer washed in the streets, then they will be washed in the cookhouse, and the washings, and probably more also, will be thrown down the drain. Moreover, the nuisance will merely be removed from the deserted street to the densely packed house, where it will be more objectionable than ever. Want of space prevents the construction of depôts where the washing could be carried on. If the public latrines were considerably increased in number, it might be possible to arrange for the performance of this operation in them.

Improved water supply best solution of this difficulty.

260. The most complete alleviation of this evil will be that caused by an increased water supply, whereby the washings will be highly diluted, and by improved house-drains and sewers, whereby they will instantly be removed. In paragraphs 101 and 102 it is shown that night-soil has no direct value to the inhabitants. The creation of a complete monopoly involves no injustice.

Public latrines desirable.

261. The public latrine is a thoroughly Chinese institution, and the majority of men use them. In Canton they are very numerous, and though no charge is made, they are most valuable property. In Hong Kong, the payment of a cash, small though the amount appears, undoubtedly occasions the commission of many nuisances. In Victoria

where so great a majority of the people are working men, they are especially valuable, giving a ready means of dealing with the excreta of so large a section of the community.

The public latrines should be acquired by Government and remodelled.

262. The existing public latrines should be acquired by Government, and after complete reconstruction, they should be thrown open to the public *gratis*. Their number also should be largely increased so that they will no longer be so crowded as to impede the operation requisite for cleanliness. The latrines having become the property of Government, dry-earth or any other improved system might be tried in them. In the Appendix I give sketches of latrines on the Canton plan, also an improvement on the present plan, and a water latrine on a plan which I found to act admirably in India. Of the first two, I prefer the Canton plan, for I found those which I visited in very good order, and it effects the most complete separation of solid and liquid excreta.* The chief object which I have had in view in designing them has been the abolition of all wood or other absorbent material and of all sharp or hidden corners which cannot be cleaned out.

Great want of urinals.

263. Urinals also are greatly needed. At present there is not a single place of the sort to which an unfortunate seaman can resort on landing. Indeed there is not one in the whole city.

Importance of clean streets. Examples of Cadiz.

264. The importance of clean street surfaces is always great, but especially so in cities having narrow streets which prevent free access of air and sunlight. In the old Spanish cities, as in those of China, the streets are very narrow, for protection against the sun; formerly they were scourged by periodical epidemics, but of late years, in Cadiz at least, these have been banished mainly by perfect paving of streets and courts, and by most careful sweeping and scavenging. The desirability of hard road surface has already been pointed out (paragraph 196).

Separation of sweeping from night-soil contract, facilitates former.

265. By the dissociation of the sweeping from the scavenging contract, much greater attention may be given to the former, and the sweeping of streets as well as courts and alleys may be done more frequently and thoroughly.

Certain private lanes should be swept by Government.

266. It seems desirable also that the sweeping of those private lanes and alleys which are practically used as thoroughfares should be performed by the public scavengers.

Want of provision for removal of house sweepings.

267. The chief want is, however, increased facilities for getting rid of ashes, house sweepings, and rubbish. At present the cook or house coolie, has either to convey them to the rubbish boats, which are only accessible from 5 to 8 a.m., or he must carry them to one of the monumental-looking dustbins which are few and far between. This is more than can be reasonably expected of him, and consequently there is the strongest temptation to get rid of the rubbish by stuffing it down drains, greatly to their detriment.

Movable dustbins to be provided.

268. It is therefore desirable that the inhabitants should provide dust boxes of some standard pattern, one for each floor, which should be put out at certain hours, so that their contents could be removed by the public scavenger. I have authority for saying that this would be a great boon to the poor.

Kiln for burning rubbish.

269. It would be desirable to construct a kiln at Lap-sap-wan, to consume the rubbish brought from the town. At present it is thrown on to the beach, and the lighter substances float away at high water, and are carried all about the harbour, which is very unsightly, to say the least. The ashes produced in the kiln might possibly be sold.

Obstruction to sweeping caused by hawkers and pedlers.

270. Hawkers and pedlers have been permitted to place their stalls on the side-channels, to an extent that is most objectionable, diminishing the already limited road space and preventing the proper sweeping of the side-channels. Frequently such obstructions are caused by vendors of cooked meat, who make a great mess with the slops from their vessels. The owners of the adjacent houses obtain rent from these people who occupy public property. My attention has been frequently called to this nuisance by Chinese.

Improved market accommodation.

271. The present market accommodation is lamentably deficient both in amount and quality. Indeed the hawker nuisance just mentioned, is principally due to the want of market space, where they can expose their wares. The central market is, I understand, wholly occupied by stalls let to regular dealers. There is no room for the peasant who brings in a boatload of vegetables. In the central market too much space is occupied by the massive masonry stalls and pillars which prevent proper cleansing. The whole should be taken down and replaced by a double iron roof supported on iron pillars. Proper benches also are required on which to place goods for sale. The floor should be asphalted, not paved, for granite blocks, unless so smooth as to be slippery, cannot be properly cleaned. Above all, the people should no longer be allowed to sleep on the stalls and benches in the market.

* The Canton plan requires continued attention and manipulation in order to maintain cleanliness. It may prove impossible to do this in the more frequented latrines.

272. Public bathhouses are much wanted for the use of the Chinese labourers. It is the custom of these people to sponge themselves over with warm water daily after their work is done. Elaborate baths are not required, only places where hot water can be obtained. Public bathing-places.

273. The washing of clothes, chiefly those of Europeans, in the mountain streams is the cause of considerable nuisance. The soapsuds putrefy in the pools of the river, and emit a most offensive smell. This has been a most fruitful source of correspondence between the civil and military authorities. The provision of a public laundry with a drying ground, so as to do away with the necessity of washing in the streams, would prevent this nuisance, be a convenience to the washermen, and effect a great saving in the linen of Europeans, by obviating the necessity for thrashing them on the rocks, and tearing them on bushes. Public laundry.

PART II.

Section 7.

Sanitary Staff.

274. I trust that I have shown that the dwellings of the Chinese working classes are inconvenient, filthy, and unwholesome. Accumulations of filth occur in and around them, both above ground, and below ground, in the drains, especially in the latter. Condition of dwellings of Chinese lower classes unsatisfactory.

275. In Hong Kong, the Chinese live under strange conditions, which are certainly not superior to those of their own country, and, in the matter of space, at least decidedly inferior. Above all the water supply is miserable. It is unjust to condemn them as a hopelessly filthy race till they have been provided with reasonable means for cleanliness. I conceive that it is the duty of the Government to see that these means are provided and applied. Hence there is the strongest necessity for inspection and supervision, especially whilst new conditions are being introduced. Chinese in Hong Kong are living under different conditions to those which obtain in China. Necessity for inspection.

276. It is, of course, necessary that every care should be taken to prevent such inspection from being inquisitorial or vexatious, and to prevent abuse of power, and the regulations should be so framed as to be, as far as possible, in accordance with the social and domestic habits of the people for whose benefit they are framed. After consultation with the Chinese, I believe that all this can be done without serious difficulty. The inspection must not be oppressive or vexatious.

277. Some of the leading Chinese stated that the entrance of officials, more particularly foreigners, into their dwellings was most disagreeable and terrifying, especially to women. I must say that in all my visits of inspection I never saw signs of either terror or disgust on the part of the inmates, or met with incivility. My Chinese informants were men of the upper classes. To them any intrusion, especially into the women's apartments, would be as disagreeable as unnecessary. With regard to the lower classes, those with whom most has to be done, I am convinced that this feeling is exaggerated, and I am sure that all that is necessary, can be done without causing any serious ill feeling. The objection to the entrance of Europeans into their houses is not nearly as great as supposed, among the lower classes at least.

278. The existing sanitary staff is composed of one head, and three sub-inspectors of nuisances, who act under the joint orders of the Colonial Surgeon and Surveyor General. (I do not include those employed in other sanitary departments, such as the application of the Contagious Diseases Act.) Composition of existing staff.

279. Now it is obviously impossible that either of these officers can, compatibly with their other numerous duties, exercise the close supervision over their subordinates which is desirable, indeed necessary. The present inspectors are recruited from the same source as the police sergeants. It is always impolitic to place men of this class in close contact with Asiatics, who rarely respect them. Low paid, they have every temptation to abuse their power; ignorant of the language, they must work through interpreters, whereby endless complications are sure to arise. In saying this, I wish to cast no imputation on the present staff, but merely to express a general principle. Colonial Surgeon and Surveyor General cannot personally exercise sufficient supervision.

280. It is therefore evident that the direct and close supervision of a special Sanitary Officer is required, who will devote his whole time to this service. He need not be a medical man or trained engineer; indeed, I do not think that any reasonable salary would tempt a competent medical man to take such a place, if deprived of private practice, which would be quite incompatible with the proper discharge of his public duties. The Sanitary Officer must be of a social position entitling him to a place on the regular Colonial staff, and he must receive an adequate salary, at least 400*l.* to 500*l.* a year. Special Sanitary Officer necessary.

281. He would personally, and through his staff, supervise the workings of the regulations for scavenging and night-soil collection, and would be responsible for the due application of all sanitary Ordinances, and of the byelaws and instructions furnished to him from time to time by the Surveyor General and Colonial Surgeon, to whom he Duties of Sanitary Officer, his relation to the Surveyor General and Colonial Surgeon.

would also report all matters, respectively technical or medical, on which he required instructions, or on which action had to be taken, such as repairs. new works. &c. Thus, whilst retaining their functions of general supervision and consultation, the Surveyor General and Colonial Surgeon would be relieved of the details of executive duties.

Sanitary Officer to be placed in office of Registrar-General. Duties of district watchmen to include cleanliness as well as maintenance of order.

282. I propose also that the Sanitary Officer should, to some extent at least, be made a member of the Registrar-General's office. The object of this is not in any way to remove him from the supervision of the officers just mentioned, but to furnish him with a powerful apparatus for enforcing sanitary law, which exists ready made in the Registrar-General's office. I mean the district watchmen. The head district watchmen are proposed by the inhabitants of the district, approved and appointed by the Governor under recommendation by the Registrar-General, or Protector of Chinese, under whose orders these functionaries are. At present their duties are connected with the preservation of order only. I propose that their powers should be extended so as to include cleanliness as well as order. If necessary, their numbers might be increased, and an addition made by Government to their salary, which is now paid wholly by the people of the district. In addition to his European inspectors, the Sanitary Officer would thus be provided with a most powerful organisation for enforcing the orders of Government, and one which is thoroughly Chinese in character. Indeed, the idea was suggested to me by the Chinese.

Routine of sanitary department.

283. The system would then be—the Colonial Surgeon and the Surveyor General give the Sanitary Officer detailed instructions under the Ordinances. Under the Registrar General, he directs the district watchmen to carry them out. He will make personal inspections himself, and control and verify those of the European sub-inspectors. In any case where his instructions leave him in doubt as to the course to be pursued, he will refer to the Colonial Surgeon or Surveyor General for instructions.

Advantages derivable from uniting Sanitary Officer with Registrar General's department.

284. To the Registrar-General the Chinese bring petitions of all kinds, they look to him as their father, and he has much influence with them, and so there would be the greatest possible facility for detecting any abuse of power on the part of the subordinates. Moreover, the Registrar-General is at present, and necessarily must be, an officer who can speak Chinese.

Limitation of power of inspectors of nuisances detracts from their efficiency.

285. At present the inspectors of nuisances are instructed not to proceed against a person committing a nuisance, unless a complaint is lodged by an inhabitant, or bonâ fide passer-by. This neutralises their powers to a very great extent. No one likes to lose a day to attend a police court, and such a step is especially repugnant to a Chinese, who above all things, dislikes making himself conspicuous, by taking legal proceedings against a neighbour.

Supervision of responsible officer removes objection to extending the power of inspectors of nuisances.

286. Any objection that may now exist to conferring more arbitrary powers, for prompt and summary action on the sanitary inspectors will disappear when they are placed under the management of the responsible Sanitary Officer, without whose sanction, and in serious cases, personal investigation, no penal proceedings will be taken.

The Chinese, it appears, are a most docile people, and are accustomed for countless generations to implicit submission to authority. Once let them see that Government is in earnest about sanitation, and that whilst giving facilities, and interfering but little with their social customs, there is a firm determination to enforce cleanliness, there will be little or no resistance, especially if the orders of the Government are promulgated in the time-honoured manner by proclamations attached to the walls of the houses. I am fully convinced that, with firm yet gentle management, and a little consideration of the wants of the people, a great improvement in general sanitary condition might be speedily effected; and that far from receiving opposition, or causing an exodus of the Chinese, it would meet with their approval.

PART III.

Villages and Kowloon Peninsula.

Observations on construction of houses in city apply with equal force to villages.

287. The observations made on the house construction and drainage of houses in Victoria, apply with almost equal force to those of the villages, several of which are rapidly assuming the proportions of small towns, and should not therefore be left wholly to their own devices.

Latrines required. Facility for removal of night-soil exists.

288. Public latrines of improved construction are required. For some time to come at least, it is probable that no special provision for house-to-house removal of night-soil may be necessary, the demand for this substance for gardens will probably suffice to secure prompt removal.

289. Provisions for removing dry rubbish and dust are required, and effective street sweeping is quite as requisite as in the city. Removal of rubbish. Street sweepings.

290. Near growing villages like Yan-ma-tee, it would be most desirable that roads should be laid out, before granting squatters licenses, or selling the land. The formation of irregular groups of houses would thereby be avoided, and the ultimate formation of proper streets would be greatly facilitated. Roads should be laid out prior to letting land for building.

291. The question of foreshore rights also requires consideration. The usual type of village consists of a double row of houses facing a street. The back of one row of houses is at or about high-water mark, so that the foreshore is cut off from the street. It becomes virtually private property, and various small jetties and other obstructions are made, which tend to cause accumulations of filth. This arrangement is perhaps convenient to those whose properties abut on the shore, but it seems doubtful whether it is beneficial to the community at large, who lose the use of the foreshore, which is usually considered to be public property. Foreshore rights of Crown to be guarded. Inconvenience from buildings close to beach.

292. Some control also should be exercised over reclamations and constructions on the foreshore. Private individuals should not be allowed to do as they like, but a general line of reclamation should be determined on. Reclamation should be regulated and carried out on some general principle.

293. As the population of the Kowloon peninsula, already considerable, is rapidly increasing, it is most desirable that no time should be lost in providing a good supply of water. The most suitable source of supply would doubtless be found in the hills of the mainland to the north. Unfortunately they are not in British territory, and therefore it will be well to examine the local supplies before resorting to them. Kowloon peninsula. Necessity of a general water supply.

294. The present supply is derived from wells, the water of which, when not directly contaminated, which too frequently happen, is of good quality. From the porous nature of the subsoil, pure decomposed granite, I think it probable that a very considerable supply may be drawn from wells. Existing supply from wells. Wells will probably afford an ample supply.

295. Even should the construction of a waterworks be deferred for the present, no time should be lost in fixing the positions of the wells, and determining the number that will be required to afford a sufficient supply. In the valleys where the most abundant supply of water will be found, the wells will be shallow, and therefore to prevent contamination, cultivation and dwellings should not be permitted near them. A certain area should be set aside for water supply. Immediate location of wells desirable so that their neighbourhood may be kept free from pollution.

296. The valley which enters the sea to the north of Yan-ma-tee, near the village of Mon-kok-tsin, seems the most promising site. The drainage area, the largest single catchment basin in the peninsula up to the point of junction of the two branches near the sea, is 300 acres. About 11 inches of rain on this area gives 20 gallons a day per head of a population of 10,000. Therefore, if about one-eighth part of the rainfall be absorbed by the soil, and re-appear in the wells, there would be a sufficient supply. It is useless to pursue these calculations any further; the yield of the wells must be ascertained by experiment. A small perennial stream flows along this valley, indicating the presence of an abundant supply of water underground. The valley joining the sea just to the north of Yan-ma-tee seems to be the most promising site for wells.

297. It is not to be supposed that one well will yield the requisite amount. Several may be connected together by a long suction pipe; better still, a long perforated pipe may be laid underground. If this project of water supply be taken into consideration, I shall be happy to give the details of the preliminary experiments required to determine the number of wells or the length of underground collector that will be required. Single well will not probably suffice. Underground collecting pipes preferable.

298. From the wells the water should be pumped by a steam-engine to a reservoir containing about 200,000 gallons situated on one of the highest hills, whence it would be distributed by means of pipes. Pumping required to a high service reservoir.

299. Just to the south of Yan-ma-tee is a sort of mud dock, which drys at half ebb, or little later. This is occupied by many boats, some of which are too old and leaky to go out, and lie here permanently, being used as dwellings. This causes a serious nuisance. Mud dock in which are unserviceable boats used as dwellings.

300. To the north of Yan-ma-tee the shore is lined with establishments for boat building or other trades connected with shipping. A road is much required. Immediately to the north of Yan-ma-tee is an old Chinese village consisting of a double row of filthy hovels without drainage. The road has been raised by successive accumulations of filth, till its surface is halfway up the walls of the houses on the sea side. Villages north of Yan-ma-tee; bad state of old villages.

301. I would call attention to the condition of the village of Hung-Nam, close to the dock property on the south-east point of Kowloon peninsula. Here there seems to be a total want of any sanitation whatsoever. Unsanitary state of Hung-Nam.

302. The village of Aberdeen consists of the usual double row of houses facing a street parallel to the shore. Those on the inland side of the street, are built close up to the base of a cliff, from whose foot a great outcrop of water takes place, consequently Aberdeen; Swampy condition causes fever.

Want of sub-soil drainage.

the ground is waterlogged, and the houses are very unhealthy. In the school-house several deaths from fever occurred, and no teacher could be found to take the place.

Aberdeen requires a supply of water which may easily be obtained.

303. At Aberdeen a supply of good water is much needed, and could be procured at small cost. An abundant perennial stream enters the sea at a short distance to the eastward. A portion of its water has been diverted to irrigate gardens above the village, and to fill a tank, used for washing nets, which is private property, whence also the inhabitants and the junks get part of their supply.

Water supply for Stanley.

304. The village of Stanley has declined in prosperity, since the abandonment of the barracks there. The water supply is deficient, being derived from shallow wells, which are nearly exhausted in the dry weather. Here also a water supply could easily be obtained from the streams to the north and east.

Village of San-Ki-Wan.

305. At San-Ki-Wan also a supply of water is required, the pipes which were put down about two years ago being defective. Side channels also are much wanted.

OSBERT CHADWICK.

19th July 1882.

APPENDIX I.—HOUSE DRAINAGE.
„ II.—LATRINES.
„ III.—TIDAL CURRENTS.

APPENDIX I.

House Drainage.

Extract from "Model Byelaws," pages 32–36, *paras.* 60–66.

60. Every person who shall erect a new building shall cause the subsoil of the site of such building to be effectually drained by means of suitable earthenware field pipes, properly laid to a suitable outfall, whenever the dampness of the site renders such a precaution necessary.

He shall not lay any such pipe in such a manner or in such a position as to communicate directly with any sewer or cesspool, or with any drain constructed or adapted to be used for conveying sewage, but shall provide a suitable trap, with a ventilating opening, at a point in the line of the subsoil drain as near as may be practicable to such trap.

61. Every person who shall erect a new building shall construct the lowest storey of such building at such level as will allow of the construction of a drain sufficient for the effectual drainage of such building, and of the provision of the requisite communication with any sewer into which such drain may lawfully empty, at a point in the upper half diameter of such sewer, or with any other means of drainage with which such drain may lawfully communicate.

62. Every person who shall erect a new building shall, in the construction of every drain of such building, other than a drain constructed in pursuance of the byelaw in that behalf for the drainage of the subsoil of the site of such building, use good sound pipes formed of glazed stoneware, or of other equally suitable material.

He shall cause every such drain to be of adequate size, and, if constructed or adapted to be used for conveying sewage, to have an internal diameter not less than "4 inches," and to be laid in a bed of good concrete, with a proper fall, and with water-tight, socketed, or other suitable joints.

He shall not construct any such drain so as to pass under any building, except in any case where any other mode of construction may be practicable, and in that case he shall cause such drain to be so laid in the ground that there shall be a distance equal at the least to the full diameter thereof between the top of such drain at its highest point and the surface of the ground under such building.

He shall also cause such drain to be laid in a direct line for the whole distance beneath such building, and to be completely embedded in and covered with good and solid concrete, at least "6 inches" thick all round.

He shall likewise cause adequate means of ventilation to be provided in connexion with such drain at each end of such portion thereof as is beneath such building.

He shall cause every inlet to any drain, not being an inlet provided in pursuance of the byelaw in that behalf as an opening for the ventilation of such drain, to be properly trapped.

63. Every person who shall erect a new building shall provide, within the curtilage thereof, in every main drain or other drain of such building which may directly communicate with any sewer or other means of drainage into which such drain may lawfully empty, a suitable trap at a point as distant as may be practicable to the point at which such drain may be connected with such sewer or other means of drainage.

64. A person who shall erect a new building shall not construct the several drains of such building in such a manner as to form in such drains any right-angled junction

either vertical or horizontal. He shall cause every branch drain or tributary drain to join another drain obliquely in the direction of the flow of such drain.

65. Every person who shall erect a new building shall, for the purpose of securing efficient ventilation of the drains of such building, comply with the following requirements :—

(I.) He shall provide at least two untrapped openings to the drains, and, in the provision of such openings, he shall adopt such of the two arrangements hereinafter specified as the circumstances of the case may render the more suitable and effectual.

(*a.*) One opening, being at or near the level of the surface of the ground adjoining such opening, shall communicate with the drains by means of a suitable pipe, shaft, or disconnecting chamber, and shall be situated as near as may be practicable to the trap which, in pursuance of the byelaw in that behalf, shall be provided between the main drain or other drain of the building, and the sewer or other means of drainage with which such drain may lawfully communicate. Such opening shall also in every case be situated on that side of the trap which is the nearer to the building.

The second opening shall be obtained by carrying up from a point in the drains, as far distant as may be practicable from the point at which the first-mentioned opening shall be situated, a pipe or shaft, vertically, to such a height and in such a manner as effectually to prevent any escape of foul air from such pipe or shaft into any building in the vicinity thereof, and in no case to a less height than " 10 feet."

(*b.*) In every case where the foregoing arrangement of the openings to the drains may be impracticable, there shall be substituted the arrangement herein-after prescribed.

One opening shall be obtained by carrying up from a point, as near as may be practicable to the trap, which, in pursuance of the byelaw in that behalf, shall be provided between the main drain or other drain of the building and the sewer or other means of drainage with which such drain may lawfully communicate, a pipe or shaft, vertically, to such a height and in such a manner as effectually to prevent any escape of foul air from such pipe or shaft into any building in the vicinity thereof, and in no case to a less height than 10 feet. Such opening shall also in every case be situated on that side of the trap which is nearer to the building.

The second opening, being at a point in the drains as far distant as may be practicable from the point at which such last-mentioned pipe or shaft shall be carried up, shall be at or near the level of the surface of the ground adjoining such opening, and shall communicate with the drains by means of a suitable pipe or shaft.

(II.) He shall cause every opening provided in accordance with either of the arrangements herein-before specified to be furnished with a suitable grating or other suitable cover for the purpose of preventing any obstruction in or injury to any pipe or drain by the introduction of any substance through any such opening. He shall, in every case, cause such grating or cover to be so constructed and fitted as to secure the free passage of air through such grating or cover by means of a sufficient number of apertures, of which the aggregate extent shall be not less than the sectional area of the pipe or drain to which such grating or cover may be fitted.

(III.) Every pipe or shaft which may be used in connexion with either of the arrangements herein-before specified shall be of a sectional area, not less than that of the drain with which such pipe or shaft may communicate, and not less in any case than the sectional area of a pipe of the diameter of 4 inches.

(IV.) No bend or angle shall (except where unavoidable) be formed in any pipe or shaft used in connexion with either of the arrangements herein-before specified.

(V.) Provided always, that for the purpose of either of the arrangements herein-before specified the soil pipe of any water-closet, in every case where the situation, sectional area, height, and mode of construction of such soil pipe, shall be in accordance with the requirements applicable to the pipe or shaft to be carried up from the drains, may be deemed to provide the necessary opening for ventilation which would otherwise be obtained by means of such last-mentioned pipe or shaft.

66. A person who shall erect a new building shall not construct any drain of such building in such a manner as to allow any inlet to such drain (except such inlet as may be necessary from the apparatus of any water-closet) to be made within such building. He shall cause the soil pipe from every water-closet in such building to be at least "4 inches" in diameter, and to be fixed outside such building, and to be continued upwards without diminution of its diameter, and (except where unavoidable) without any bend or angle being formed in such soil pipe to such a height and in such a position as to afford, by means of the open end of such soil pipe, a safe outlet for sewer air.

He shall so construct such soil pipe that there shall not be any trap between such soil pipe and the drains, or any trap (other than such as may necessarily form part of the apparatus of any water-closet) in any part of such soil pipe.

He shall also cause the waste pipe from every bath, sink (not being a slop sink constructed or adapted to be used for receiving any solid or liquid filth), or lavatory, the overflow pipe from any cistern and from every safe under any bath or water-closet, and every pipe in such building for carrying off waste water to be taken through an external wall of such building, and to discharge in the open air over a channel leading to a trapped gully grating at least 18 inches distant.

He shall, as regards the mode of construction of the waste pipe from any slop sink constructed or adapted to be used for receiving within such building any solid or liquid filth, comply in all respects with such of the provisions of this byelaw as are applicable to the soil pipe from a water-closet.

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1. The above extract from the "Model Byelaws" promulgated by the Local Government Board gives, in general terms, the points to be observed in order to secure effective house drainage. It will be seen that the system of house construction which obtains in Hong Kong renders it impossible, in the case of many existing buildings, to satisfy all the prescribed conditions. For example, in back-to-back houses the drain must pass under the house (byelaws, para. 62), and the drain must have an inlet within the house (byelaws, para. 66). It is possible, however, to follow the general spirit of the precepts, and to make such arrangements as will reduce to a minimum the chance of evil results from these deviations from strictly correct practice.

System of house construction in Hong Kong in the case of old houses prevents fulfilment of requirements laid down in byelaws.

2. In the case of a great majority of dwellings, the poorer class, it is obvious that the cost of the works must be reduced to the minimum amount consistent with efficiency. Hence, the simplest and cheapest means to secure the desired end must be employed. In some cases facility for inspection and repair must, to some extent, at least, be sacrificed to economy in construction.

Economy second only to efficiency in importance.

3. Nevertheless, in the vast majority of cases, good design and good workmanship will secure all the essential requirements of good drainage. True and accurate work greatly reduces the chances of stoppages, and diminishes, indeed obviates, the necessity for the more elaborate provision for their removal, whilst good design derives the maximum efficiency from simple means.

With bad workmanship, however elaborate be the system adopted, failure is certain. This is a most forcible argument for the execution of such work by Government, who alone can secure the services of an efficient staff for this purpose. Other equally cogent reasons will be given later.

Good design and workmanship alone will secure efficiency. They can only be attained by execution of work by Government.

4. In addition to the general conditions prescribed in model byelaws referred to, there are certain technical requirements, the necessity for which has been demonstrated by experience, and to which attention must be paid to secure good results.

Technic points to be attended to in addition to general requirements.

5. The discharge of sewage from any individual house is both intermittent and highly irregular in amount, depending in a great measure on the habits and occupations of the inmates, as the volume to be carried off is an unknown quantity; hydraulic formula afford no assistance in determining the necessary dimensions and slope of the pipe. It has been found that a 4-inch pipe with a fall of 1 in 30 will, under ordinary circumstances, serve every purpose and keep free from deposit and obstructions. This size, therefore, has been adopted as the standard house drains, and a fall of 1 in 30 is also the minimum, and as much more fall should be given as is practicable.

Gradient or fall required for house drains and street sewers.

It must be remembered that a pipe of this size with this fall is capable of carrying off vastly more than the sewage of any one dwelling. The use of smaller diameters has been found to be undesirable on account of their liability to obstruction by solid substances casually introduced, and because of the resistance to the circulation of air in ventilation which they offer, and above all because of the difficulty of obtaining small pipes true and straight.

For this reason also 6-inch pipes are often used for house drains where 4-inch pipes would fully suffice to carry off the sewage and even the rain water. This is specially so where the work cannot be executed under close supervision.

There can be no doubt that a 6-inch pipe is much less liable to casual obstruction by bits of rag, &c. than a 4-inch, but it is not less liable to deposit, rather the reverse.

It is unfortunate that 5-inch pipes are not usually made. They would probably combine the advantages of both sizes.

If ordered in large numbers, or manufactured in China, pipes of any desired diameter could be obtained.

With careful workmanship 4-inch pipes will suffice for house drains.

Although a 4-inch pipe is fixed as the minimum size, it is neither necessary or desirable to augment the size of a drain *pro rata* to the number of 4-inch house drains which it receives. The following calculation shows this.

We may assume that the volume of the affluent from any dwelling is about equal to the water supply. In this case 10 gallons a head a day will be a most liberal estimate. In the poorer class of houses there will be at least 16 inhabitants per house, so that the discharge will amount to 160 gallons a house a day, of which about one half will pass off in 8 hours. The maximum rate of discharge will be 10 gallons per hour per house. Now, a 4-inch pipe at a fall of 1 in 30, running *half* full, delivers about 6,000 gallons per hour, so that such a pipe would carry off the sewage of 600 such houses with a margin of 100 per cent. for casual increase. Even if the gradient be reduced to 1 in 90, a 4-inch pipe will suffice to remove the sewage of nearly 300 houses, whilst the velocity of flow will still be sufficient to prevent deposit. There is, therefore, a direct advantage in concentrating the effluent of a large number of houses in a pipe no larger than that used for a single dwelling.

As the rate of flow from single houses or even from small groups of dwellings cannot be predicted with accuracy, and because of the difficulties as to accuracy of form and the obstruction to ventilation already mentioned, it may not be desirable to reduce dimensions, and especially gradients to the ultimate limit indicated by such calculations. They serve, however, to show the very moderate dimensions that will suffice, dimensions far less than those employed at present.

The discharge from large districts may be more readily estimated, for the individual irregularities tend to equalise one another, and therefore in fixing the proportions of main sewers the results of calculation may more be closely adhered to than in the case of small areas.

6. To secure freedom from deposit, the velocity in sewers should be from 2·5 feet to 3·0 feet per second according to various authorities. It is reasonable to suppose that a higher velocity is requisite to break up and remove deposit than to prevent its formation.

Hence, in branch sewers where the flow is intermittent the higher velocity should be adopted, whilst in main sewers, where the movement is more regular, a lower velocity may be admissible.

Self-cleansing velocity gradient being limited, diameter is determined irrespective of effluent to be dealt with.

The velocity of flow through a pipe running full or half full is a function of two variables, the diameter and the gradient. The velocity being fixed by the conditions just stated, it is obvious that, when, as is frequently the case, the available fall is also fixed by local circumstances, the diameter is determined by these considerations alone, apart from the question of the volume to be conveyed.

Inasmuch as the proper velocity is only obtained when the pipe is half full, and diminishes as the depth diminishes, slowly at first, but more rapidly afterwards, in order that a sewer may be self-cleansing, it is necessary that the volume of water passing through it should at intervals, at least, be sufficient to fill it to the depth that will produce the desired velocity.

For example, with a fall of 1 in 440 a 20-inch pipe running half full has a velocity of 3 feet per second, that required, and discharges about 3·27 cubic feet per second. With a depth of 2 inches only, in the pipe, the velocity is reduced to 1·7 feet per second, and the discharge to about 0·19 cubic feet per second. To prevent or remove deposit, therefore, it would be necessary that once a day at least the rate of discharge must reach 3·27 cubic feet.

Inadequate quantity of effluent necessitates flushing.

If the natural flow does not reach the required amount, then it must be supplemented by occasional flushing. Field's flush tank affords a most simple means of doing this, as it enables any given quantity to be discharged automatically at any desired rate or interval of time into a sewer or drain.

Moreover, it is not necessary to use clean water for this purpose, sewage from a higher district may be collected and thus employed to flush lower levels.

The use of the flush tank is, therefore, recommended in those cases where the gradient is limited, and where there is doubt as to the adequacy of the natural flow.

Accuracy of work requisite, precautions to be observed in laying pipes.

7. For the realisation of the proper velocity due to the fall it is essential that pipes should be even, true, and straight, and that there should be no roughness or irregular projections on its inner surface. Depressions also are most objectionable, for in them deposit takes place during the intermissions of flow which may not afterwards be removed.

Care is, therefore, necessary in laying the pipes. To secure true line, as long a length of trench as possible should be excavated at once, and its bottom carefully graded, before putting in the pipes. If practicable, the whole length between two bends or junctions should be excavated at once. By the ordinary plan of laying the pipes, and filling in the earth as the excavation proceeds, it is quite impossible to secure the necessary accuracy. When the trench is completed, the pipes should be laid to a line stretched along, and before jointing, they should be firmly bedded behind the socket in their final position, leaving just room to make the joint. The joints should be made with Portland cement, and the greatest care should be taken to prevent a ragged fringe of cement from protruding from the joint, inside the pipe. To remove any cement that may exude from the joint into the pipe, a long rod with a round head covered with rag is used to wipe out the pipe.

When drains have to pass through the walls of buildings, especially when newly erected, abundant clearance must be left both above and around the pipe. If firmly connected to the wall, the least settlement will cause fracture and leakage.

When the ground is soft, the pipe should be bedded in concrete.

Standford's joints favourable to accuracy, but expensive and hitherto untried in tropics.

8. Standford's patent joints make excellent work, and require no cement or other composition for jointing. The spigot and the inside of the socket are provided with bands of a certain composition, carefully shaped, so that they mutually fit each other. All that is necessary is to press the spigot slightly greased into the socket, and a perfectly water-tight joint is at once formed. They cost, however, nearly 40 per cent. more than ordinary pipes, and experience is wanting as to the behaviour of the composition under high temperature, such as that to which they would be exposed in the hold of a ship. It might be well to send out a small number as an experiment.

Pipe drain once broken restored with difficulty. Necessity for manholes, turning and inspection chambers, to give access without necessity for disturbance.

9. When a pipe drain is broken for any purpose, such as to remove an obstruction, it is almost impossible to restore it to its original condition of accuracy. Obstructions usually take place at bends, junctions, or syphons. At such places, therefore, special means of access should be provided. Between these points the pipe should be absolutely straight, so that a jointed rod may be passed up to remove obstructions if they do occur, which should be exceedingly rare in well constructed work.

The most complete method of doing this is to make all bends and junctions in the form of open channels, in the floor of a chamber of sufficient size to admit a man (manhole).

In street sewers this should always be done, but the cost will often be too great in case of house drains. In these cases either a smaller turning or inspection chamber should be used, or an inspection cap, or small lid on the top of the pipe which at least allows examination to be made without breakage, and in many cases they can be so arranged that a rod can be passed down the pipe from them. At all syphons also either manholes or inspection chambers should be used.

Prime cost of pipes serious item. Possibility of manufacturing pipes in China.

10. The price of pipes will be a most serious factor in the cost of the works. I, therefore, made inquiries as to the possibility of obtaining suitable pipes in China. Through the kindness of Dr. Kew, of Canton, I found out and visited the potteries of Shek-Wan, a town situated on a creek of the Canton river, about 20 miles from that city. Some pipes were made to a pattern which was sent, one of which is now in my possession. They appear to be of excellent quality, and with a little improvement, as to regularity of dimensions, would be quite suitable for drainage purposes. The price paid for these pipes, 10 in number only, was $80 \cdot 20$ each, or about 5*d.* a foot, or rather less than what English pipes would cost delivered in Hong Kong, including freight. For larger orders a much lower price would be asked, so that I believe, with a little trouble, pipes may be procured in China at little or no greater cost than in London.

Description of drawings. Removal of slop water only provided for, but drains equally suited to convey excreta if desired.

11. Plates I. and II. show methods of draining some common types of houses, according to the principles just enunciated.

Provision is made for the removal of slop water only, but, as stated in the report, drains fit for that purpose are fit for the conveyance of excreta also, so that when the time comes, they can easily receive the additions necessary to fit them for this additional duty. No provision is made for removal of rain water which should be dealt with separately for the reasons stated in the report. The dimensions are, however, ample to receive a considerable quantity of rain, to carry off all would be clearly impossible.

Description of Plate I., showing method of draining a single back-to-back house to the street in front.

12. Plate I., Figs. 1, 2, 3, shows a method of draining a single house built back-to-back with one behind, so that the drainage must be carried out to the street in front. This is, perhaps, the most inconvenient and costly condition that will be met with.

At a short distance from the street sewer a 4-inch stoneware syphon or trap is placed to prevent the escape of gas from the sewer to the house drain.

This syphon is provided with a second oblique junction, into which a 4-inch pipe is adapted, which is carried up to the surface of the street where its opening is covered with a cast-iron grating.

This serves, firstly, as ventilating inlet, and secondly, for inspection and removal of obstruction. By lifting the grating a hook or spoon may be passed down into the syphon, and any deposit removed. The diagonal plate prevents children from dropping stones down the pipe.

From the syphon the drain runs straight to the cookhouse, where there is a V junction. One branch leads to the slop stone in the lower cookhouse, where escape of gas is again prevented by a Doulton's stoneware gully or trap. This is placed beneath the slop-stone, which is slightly raised above the floor, in order to prevent the introduction of rubbish. It is to be hoped that the provision of increased facilities for the removal of sweepings and rubbish as recommended in the report will remove the temptation to put them down the drain, a practice fatal to any system of drainage.

The second branch communicates with an upright pipe which is carried up above the roof, and which is open at the top.

This pipe serves as a ventilating outlet, thus completing the system of circulation, and it also receives the drainage from the slop-stone in the upper cookhouse, which is likewise provided with a Doulton's gully.

As the flimsy construction of the floors, which too often obtains, may occasion great difficulty in fixing a gully, an alternative method of dealing with the drainage of the upper storey is shown in dotted lines in Fig. 2. The slops are carried down in a plain pipe which delivers *over* the sink in the lower cookhouse. As this pipe is completely disconnected, no gas can enter it, and, therefore, there is no necessity for a second gully.

The ventilating pipe would still be required, but as it carries no fluid, it may be made of any suitable material, such as zinc, cast iron, or even the rough earthenware pipes surrounded with plaster might be employed, similar to the down pipes at present used. Provided always that the clear diameter be not less than 4 inches. Smaller ventilating pipes than this are found to be useless, for they oppose too much resistance to the passage of the air, and they are liable to obstruction by spiders' webs, insects' nests, mice, &c.

The ventilating pipe is covered above with a plain cap, to keep out birds, &c. A simple open-topped pipe has, so far, been found to give as good results as any of the elaborate caps or cowls which from time to time have been recommended.

For the sake of clearness no means of fixing the upright pipes has been shown. They might be attached to the wall by hoops, or they might be supported by encrusting them with plaster, after the manner of the country.

As to the provision for removal of obstructions. The most probable place of occurrence will be at the gullies or traps.

These can be cleaned out by simply lifting the slop stone.

Next, as to liability to stoppage, is the syphon, which may be cleared, as described, from the ventilating inlet. Lastly, a stoppage may occur at the junction of the two branches, or in the main pipe leading from it, and this contingency is provided for by the long inspection cap. By taking up a few paving stones the lid may be taken off, and a long jointed rod, or long rattan, may be forced down the main pipe, or up either of the short branches.

The means of access thus provided are not perfect, for this involves the breaking up of pavement. They will suffice, however, for all ordinary cases, and they are as much as can be afforded in a single dwelling.

After all, stoppages will be very rare, especially when there is a reasonably abundant water supply, and when the people have become used to the new system.

In the next drawing more complete methods are shown, the expense of which will be justified as they are designed to serve a group of dwellings.

Description of Plate II., combined drainage of four houses. Combination for this purpose,

13. Figs. 6 and 7, Plate II., show the method of draining a group of four houses, built on the back-to-back system; and in red dotted lines an arrangement is shown whereby four more houses might be combined with the same system.

The economy resulting from the combination of several houses is obvious, and justifies the use of more complete appliances than is possible in the case of the independent treatment of a single house.

Left to themselves the owners of adjacent houses would probably find it impossible to come to arrangements necessary for this favourable combination. The intervention of a strong central authority, such as the Government, alone can bring about the desired union. Here again is another strong reason for the governmental execution of the work of drainage. can only be brought about by Government.

14. The drains from the four slop stones meet in a manhole, beneath the floor of one of the central cookhouses. The manner of uniting the streams of the various pipes by means of open channels is shown. They are curved, so as to avoid sudden changes of direction, which retard the flow and tend to cause deposit and obstruction. These curved channels, which are very important, may either be formed of half-round tiles made to the sweep, or they may be moulded in cement plaster, finely rendered. The manhole is covered with slab-stones or any other convenient covering. Description of Figs. 6 and 7, Plate II.

This manhole gives complete access to the four branches and to the main pipe. The lower slop stones are provided with gullies, but the drainage from the upper floors is delivered *over* them, as in the alternative plan shown in Plate I., Fig. 2., so that no gully traps are required upstairs.

Neither are they wanted for the four slop stones of the cookhouses in rear (shown in red dotted lines), for by slightly raising them their drainage may be delivered *above* those in front.

The two long lateral branches to the outer cookhouses are provided with ventilating pipes, which are carried up above the roof, and serve for ventilation only.

The disconnecting manhole, in the street, gives access to the syphon, and also to the drain under the house. A V-junction is shown just beyond the syphon, from which a 4-in. pipe is carried back to the manhole, the opening being closed by a cap. By this means a rod may be introduced into the pipes beyond the syphon to clean it. This is very desirable if the distance beyond the trap is great, but it is scarcely necessary with the short length shown in the drawing.

The disconnecting manhole also serves as a ventilating inlet.

For this purpose a small vertical grating is fixed in the kerb of the footpath. With the two ventilating pipes already mentioned the system of circulation is complete, for it will be observed that there is no trap or obstruction between inlet and outlet.

Another method of fixing a ventilating inlet is shown in Figs. 8 and 12. Here a 6-in. pipe is carried from the manhole to a chase, cut in the wall of the house, a vertical grating being fixed at the opening.

The dotted lines in Fig. 6 show how the drainage from other groups of houses might be carried into the same disconnecting manhole.

Figs. 10 and 11 show a simple form of inspection bend, for situations in which it may not be desirable to construct a manhole or turning chamber. A block moulded in concrete has a semicircular channel formed in it, and it is covered above by a lid. A 6-in. pipe affords means of inspection and ventilation also if desired.

By taking off the lid the two branches of pipe may be cleared without disturbing or breaking any joint.

15. Figs. 8 and 9 show the manner of draining into a back alley. Here no pipe whatsoever enters the house. The slops from the sinks, both upstairs and on the ground floor, are carried out, at once, through the wall of the house, and delivered over gullies in the alley, so that there is the most complete disconnexion possible. The drain down the alley is ventilated by a pipe at one end, and by an inlet, communicating with the disconnecting chamber, at the other. The latter also, with the turning chamber, gives complete access to the pipe. As a further precaution, however, each junction is provided with an inspection cap, which adds but little to the cost. Back drainage into an alley.

This is by far the most satisfactory arrangement of all.

It would be well if it could be more frequently adopted. The facilities to drainage afforded by back alleys are so great, that apart from all other considerations, they should be insisted on in all new buildings wherever possible.

16. From the somewhat elaborate provisions for the removal of stoppages, shown in the drawings, it might be inferred that such misfortunes are of frequent occurrence. With good workmanship, however, this is not the case, but, in the absence of some such provisions, the damage and inconvenience caused by repairs is so great, that it has been found desirable to adopt them, and I have, therefore, shown the different artifices used for this purpose. With good workmanship stoppages should be very rare.

It may be that local conditions will render such complete appliances less necessary. This is a point that can only be decided by trial. The experience gained in draining a few blocks will soon show what simplifications may be ventured on.

Construction of waterclosets, baths, and sinks.

17. Plate III. shows the method of fixing waterclosets, baths, and sinks in accordance with the principles laid down.

Pipes to be placed outside house, ventilation and disconnexion.

18. Figs. 1 and 2 show two closets with the necessary apparatus and fittings. The pipes from them are carried out, at once, through the wall of the house, and there connected to a vertical soil pipe, which is carried up full size (4 inches) to the top of the house, thus serving as a ventilating outlet. This ventilating pipe should be carried up as straight as possible above the highest windows.

If there were windows in the roof it might be necessary to carry it up as shown in the dotted lines, but bends should be avoided as much as possible. The whole arrangement is disconnected from the town sewer by a syphon trap and ventilating inlet, in the manner already shown in Sheets I. and II. It will not be necessary to provide disconnexion for each set of closets, one syphon and ventilating inlet may often be made to serve for a whole building, but no branch of any considerable length should be without a ventilating outlet, and no trap or other obstruction to free circulation of air must be interposed between each or any of the outlets and the common inlet.

In Figs. 1 and 2 I have shown the disconnexion effected by a simple syphon and inspection pipe, the latter serving as ventilating inlet.

In Figs. 3, 4, 5 more complete arrangement of a disconnecting manhole is shown.

In all important buildings it will be well to incur the extra expense of the manhole on account of the many advantages possessed by it.

Pan closets and D traps condemned.

19. The arrangement known as the pan closet, with D traps, should on no account be used.

It is found that hidden accumulation of filth takes place in it, causing a nuisance, no matter how perfect be the arrangement of drains to which it is connected.

Water supply; waste prevention.

20. To provide a continuous supply of water a cistern is fixed in the roof. Even with a constant supply this is requisite to meet the occasional interruptions that must from time to time take place, and also because the mains must not be connected directly to the closet for fear of contamination to the water supply. The water from this cistern must, on no account, be used for any other purpose than for the closets.

Different patterns of closets; flushing and waste-preventing cisterns.

21. On the upper storey, one of Tylor's patent closets is shown, a very perfect but expensive arrangement. In it the pan is closed below by a flat valve, which falls down and allows the contents to escape.

On the lower storey a much cheaper, but for most purposes, sufficiently effective arrangement is shown. Here there is no valve at all, but the flush of water from the small cistern above sweeps all before it through the trap, which, in this case, is of stoneware. The mechanism attached to this cistern is so arranged that by pulling the chain for an instant only the whole of its contents, three gallons, is rapidly discharged, thus securing a powerful flush, the effectiveness of which depends more on the rapidity of discharge than on the absolute quantity of water used. To this end the service pipes are made of greater diameter than is usually the practice ($1\frac{1}{2}$ inches and $1\frac{1}{4}$ inches respectively).

Water waste prevention.

22. This cistern also serves as a water waste preventer, for there is an arrangement by which even if the chain be held down it is impossible to produce a continuous stream of water.

An arrangement, having the same object, is provided in the valve of the Tylor's closet also.

Overflow pipes are not to be connected to drain, but must have their outlets visible.

23. A lead trap or "safe" is placed beneath each closet to catch any leakage or overflow.

The small overflow pipes from these safes, from baths, and also from cisterns, must on no account be connected with any soil-pipes or drain, but their openings must be placed in the open air so as to be easily visible, for two reasons: Firstly, because by connecting them to a drain a free passage for sewer gas into the house would be made. These pipes only come into action in the event of some derangement of the mechanism, and consequent leakage. For long periods, therefore, nothing passes through them, and therefore the water evaporates from any syphon or trap, which may be provided, leaving a free passage for gas. Secondly, if connected to drains, leakage would go on undetected. On the other hand by leaving their mouths exposed, any water issuing from them causes a mess and a nuisance, attention is called to the leakage, and it is remedied. In my report I have already called attention to the necessity of preventing waste. For this purpose alone it is absolutely necessary to adopt in all cases this arrangement of waste and overflow pipes.

Improperly fitted baths and sinks

24. Fully as much danger to health is caused by improperly arranged baths and sinks as by imperfect closet arrangements.

HOUSE DRAINAGE OF HONG KONG.

SCALE ½ INCH TO ONE FOOT.

SHEWING METHOD OF DRAINING A SINGLE HOUSE WHERE THERE IS NO BACK ALLEY

SHEET Nº 1.

FIG 1
LONGITUDINAL SECTION.

FIG 4.

INSPECTION CAP
½ FULL SIZE.

FIG 5.

DOULTONS CULLY
½ FULL SIZE.

FIG 2.
CROSS SECTION.

The dotted lines shew an alternative plan whereby ventilator is used for ventilation only and trap and junction on upper storey are done away with. The down pipe then delivers over gully below and is untrapped.

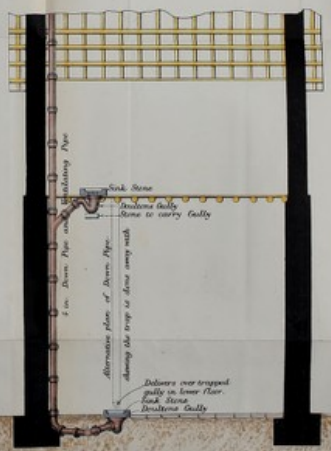
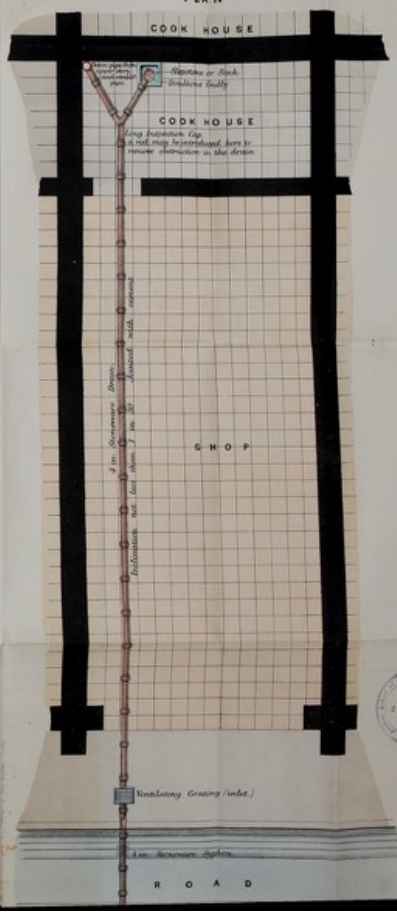


FIG 3.
PLAN



HOUSE DRAINAGE OF HONG KONG.

SHEET No

FIG 6.

SHEWING MODE OF UNITING DRAINAGE OF FOUR HOUSES AND CARRYING IT DIRECT TO STREET IN FRONT.

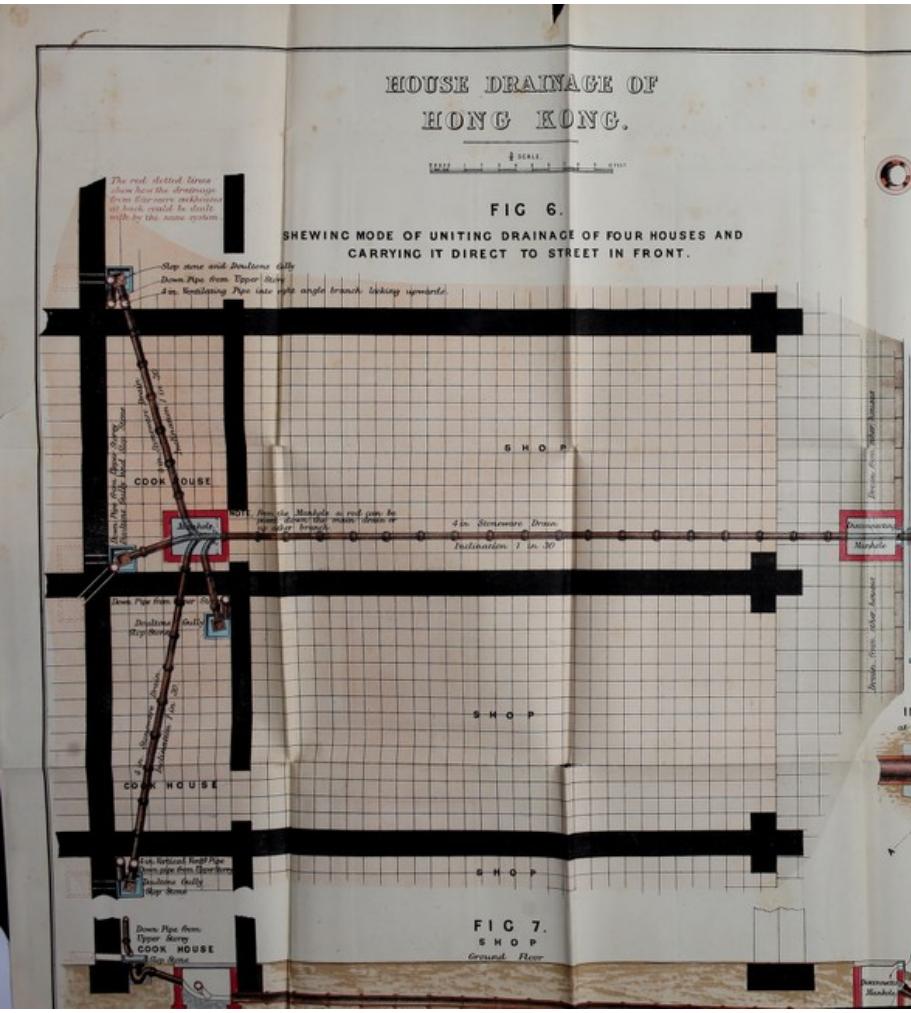


FIG 7.

SHOP

Ground Floor

FIG 13.

FIG 9.

SECTION ON LINE A. B.

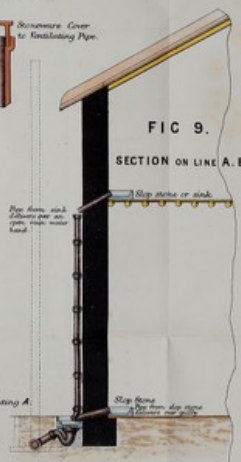


FIG 10.

SECTION OF INSPECTION BEND ON LINE A. B.

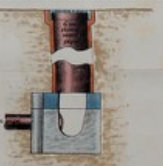
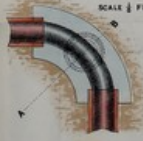


FIG 11.

INSPECTION BEND

at change of direction in pipe.

SCALE ½ FULL SIZE.

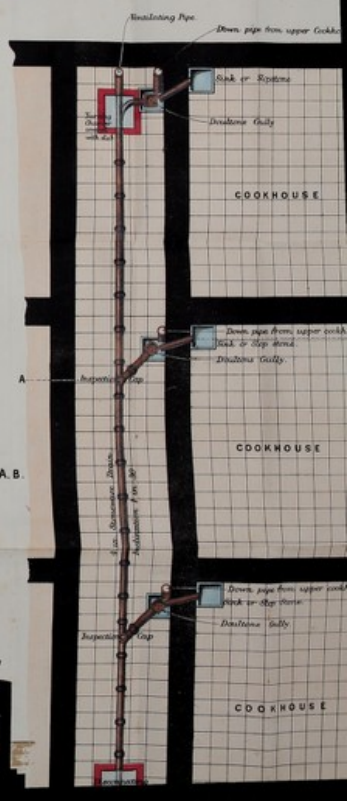


Section of Disconnecting Manhole. Fig 8.

FIG 12.

FIG 8

SHEWING BACK DRAINAGE INTO AN ALLEY



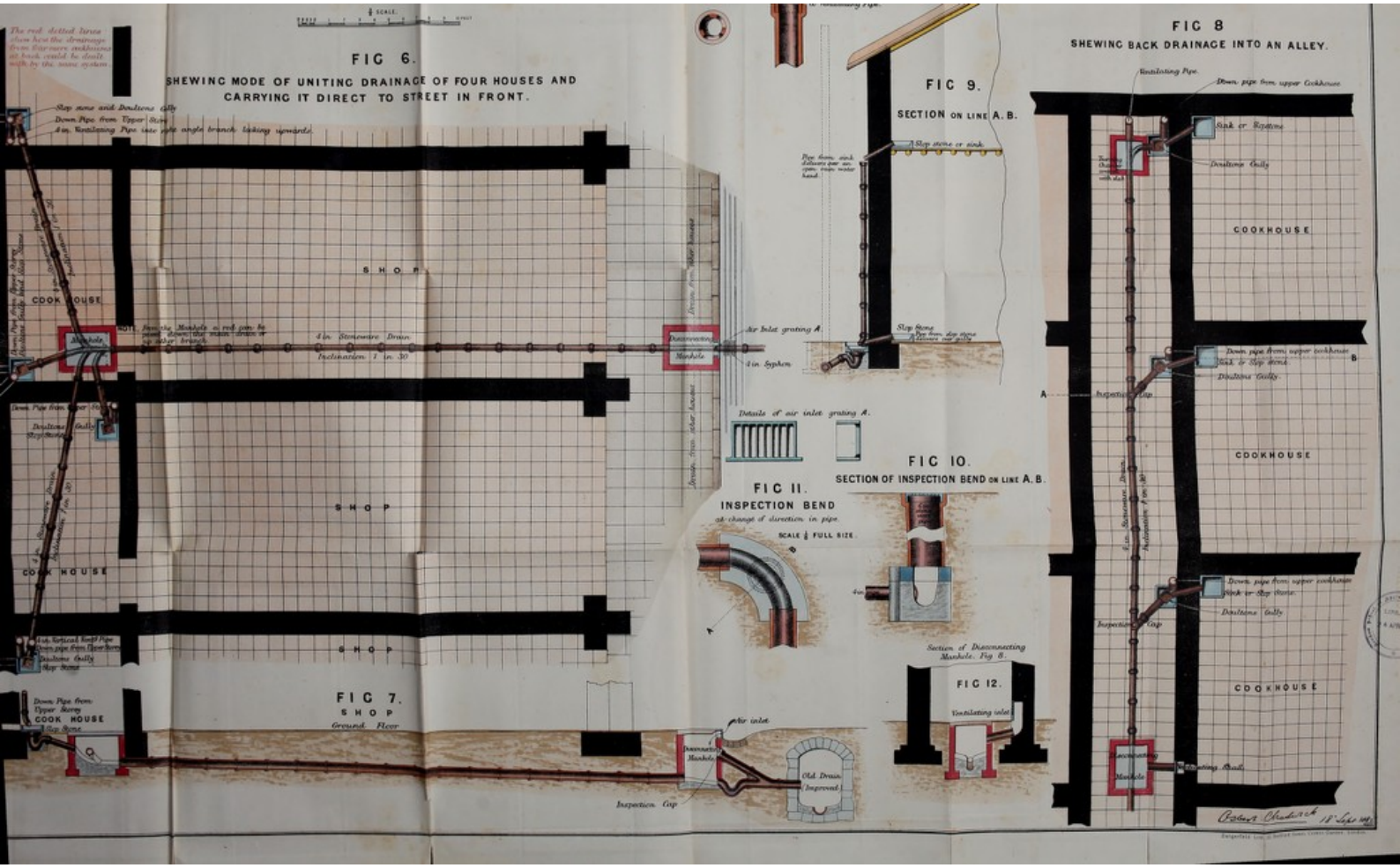
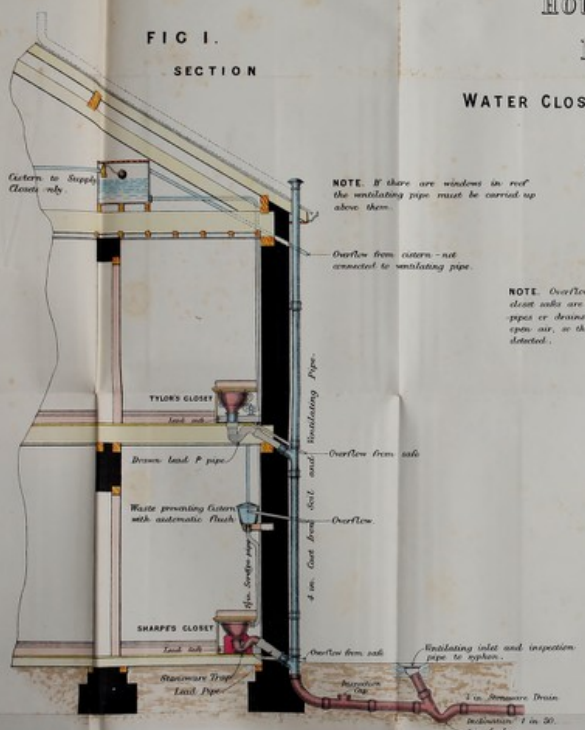


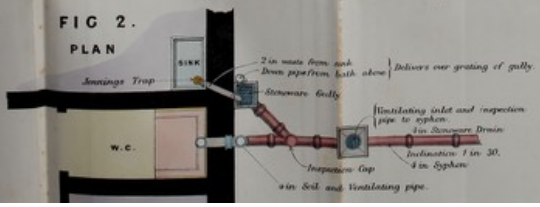
FIG 6.
SHEWING MODE OF UNITING DRAINAGE OF FOUR HOUSES AND CARRYING IT DIRECT TO STREET IN FRONT.
SHOP
COOK HOUSE
Manhole
4 in. Stoneware Drain
Inclination 1 in 30
Disconnecting Manhole
4 in Syphon
Air Inlet grating A.
Down Pipe from Upper Storey
Sink & Slop stone
Drain from other houses
FIG 7.
SHOP
Ground Floor
Down Pipe from Upper Storey
COOK HOUSE
Slop Stone
Air inlet
Disconnecting Manhole
Old Drain Improved
Inspection Cap
FIG 9.
SECTION ON LINE A. B.
Slop stone or sink
Pipe from sink delivers over an open slop water hand
Slop Stone
Details of air inlet grating A.
FIG 10.
SECTION OF INSPECTION BEND ON LINE A. B.
FIG 11.
INSPECTION BEND
at change of direction in pipe.
SCALE ½ FULL SIZE.
Section of Disconnecting Manhole. Fig 8.
FIG 12.
Ventilating inlet
FIG 8
SHEWING BACK DRAINAGE INTO AN ALLEY.
Ventilating Pipe.
Down pipe from upper Cookhouse
Sink or Syphone
Drain from other houses
COOKHOUSE
Down pipe from upper cookhouse
Sink or Slop stone
Drain from other houses
Inspection Cap
COOKHOUSE
Down pipe from upper cookhouse
Sink or Slop stone
Drain from other houses
Inspection Cap
COOKHOUSE
Disconnecting Manhole
Robert Rudduck 18 Lisson Grove

HOUSE DRAINAGE OF HONG KONG.

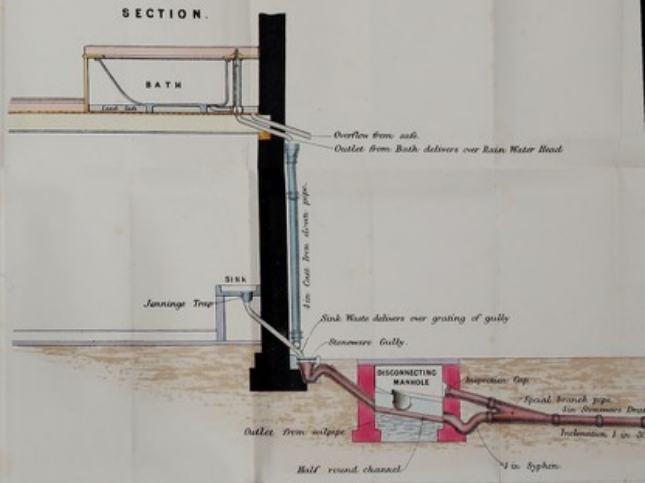
WATER CLOSETS—BATH AND SCULLERY SINK.

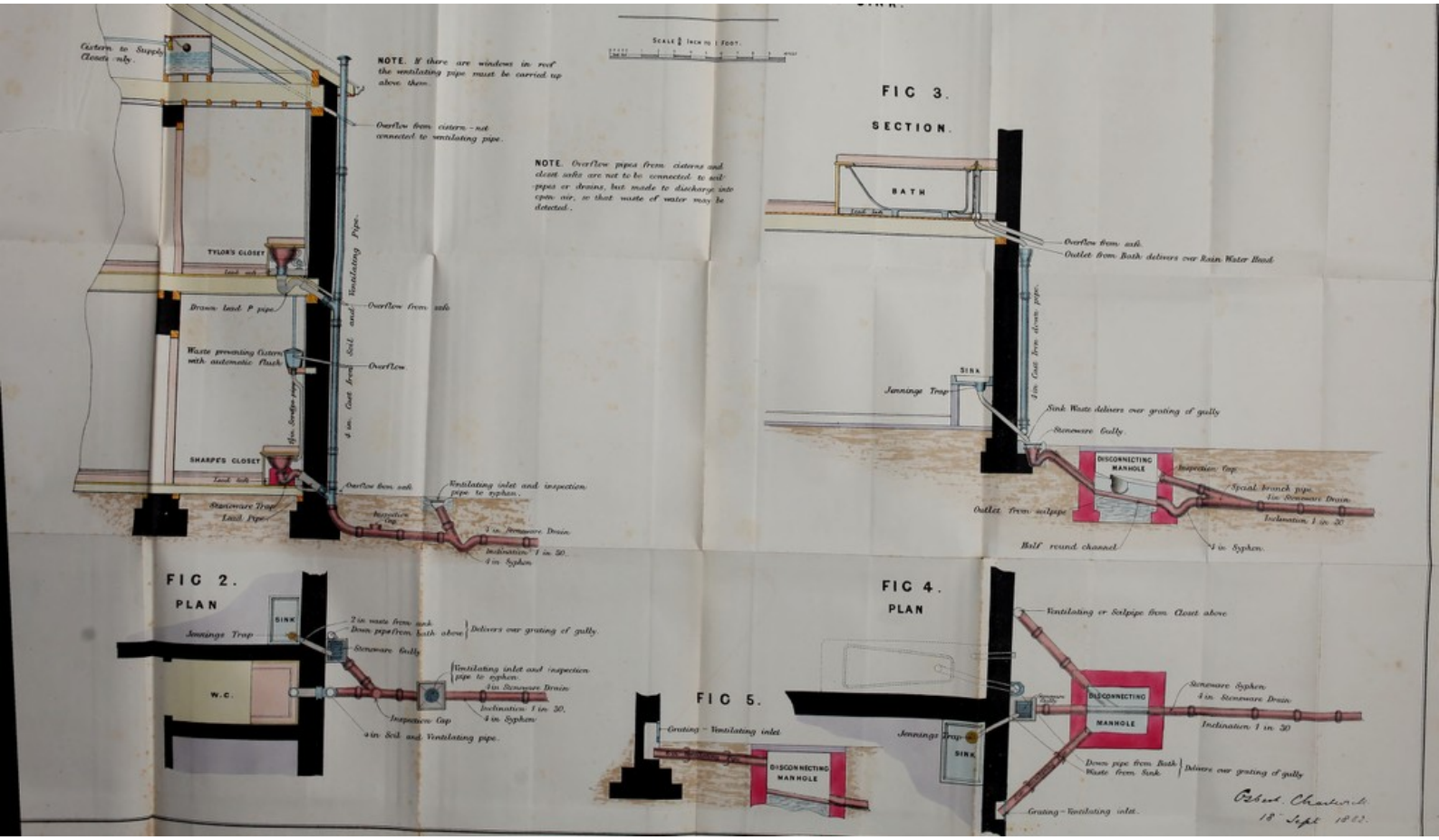
SCALE ½ INCH TO 1 FOOT.





NOTE. Overflow pipes from cisterns and closet walls are not to be connected to soil pipes or drains, but made to discharge into open air, so that waste of water may be detected.




Cistern to Supply Closets only.
NOTE. If there are windows in roof the ventilating pipe must be carried up above them.
Overflow from cistern - not connected to ventilating pipe.
NOTE. Overflow pipes from cisterns and closet sinks are not to be connected to soil pipes or drains, but made to discharge into open air, so that waste of water may be detected.
TYLOR'S CLOSET
Lead sink
Drawn lead P pipe
Overflow from sink
Waste preventing Cistern with automatic flush
Overflow
15in. Soil pipe
4 in. Cast Iron Soil and Ventilating Pipe.
SHARPE'S CLOSET
Lead sink
Overflow from sink
Ventilating inlet and inspection pipe to syphon.
Stoneware Trap
Lead Pipe
Inspection Cap
3 in. Stoneware Drain.
Inclination 1 in 30.
4 in. Syphon
SCALE ½ INCH TO 1 FOOT.
FIG 3.
SECTION.
BATH
Lead Sink
Overflow from sink.
Outlet from Bath delivers over Rain Water Head.
3 in. Cast Iron closets pipe.
SINK
Jennings Trap
Sink Waste delivers over grating of gully
Stoneware Gully
DISCONNECTING MANHOLE
Inspection Cap
Spiral branch pipe.
3 in. Stoneware Drain.
Inclination 1 in 30.
Outlet from soilpipe
Half round channel
4 in. Syphon.
FIG 2.
PLAN
SINK
Jennings Trap
2 in waste from sink
Down pipe from bath above
Delivers over grating of gully.
Stoneware Gully
W.C.
Ventilating inlet and inspection pipe to syphon.
3 in Stoneware Drain
Inclination 1 in 30.
4 in Syphon
Inspection Cap
4 in Soil and Ventilating pipe.
FIG 4.
PLAN
Ventilating or Soilpipe from Closet above
DISCONNECTING MANHOLE
Stoneware Syphon
4 in. Stoneware Drain
Inclination 1 in 30
Jennings Trap
SINK
Down pipe from Bath
Waste from Sink
Delivers over grating of gully
Grating - Ventilating inlet
FIG 5.
Grating - Ventilating inlet
DISCONNECTING MANHOLE
Robert Chadwick
18 Sept 1862.

Figs. 3 and 4 show the method of fitting a bath and a scullery sink. The waste pipe from the bath passes at once through the wall of the house and discharges above the open head of a down pipe, which again delivers above the grating of a trapped gully. In like manner the waste pipe from the sink discharges above the gully. The trap beneath the sink is rather a luxury than a necessity. Its chief use is to prevent the entrance of a draught of cold air.

are fully as dangerous to health as badly arranged waterclosets.

25. By the intelligent application of the principles of disconnexion and ventilation, coupled with complete freedom from deposit in the house drains, which may be secured by good workmanship, the inhabitants of any house may make themselves practically independent as to the interior of the dwelling, of the condition of the public sewer. That is to say, the entrance of sewer gas from sewer, drain, or even cesspool, may be rendered impossible. It need hardly be said that these arrangements do not obviate the pollution of the air by sewer gas in the street, but they cannot fail to diminish the quantity generated by discharging the effluent before putrification has commenced.

Ventilation and disconnexion render interior of dwelling independent of the condition of public sewer.

Closets or latrines should always have one, preferably three, outside walls. In hospitals they should be placed in a projecting tower, separated from the main building or ward by an ante-room, provided with windows at each side, so as to secure a thorough draught.

To sum up,—

Summary of principle.

26. The principles ruling the designs of sewers and drains may be thus briefly stated.

(1.) Permanent deposit must not take place in any channel (pipe, drain, or sewer).

(2.) To prevent permanent deposit the velocity in any given channel must for a certain period daily at least be not less than that required to remove deposit, call this said velocity the "self-cleansing velocity."

(3.) Therefore the channel must have in inclination not less than that requisite to produce during an appreciable daily period of greatest average discharge the "self-cleansing velocity."

(4.) If the conformation of the ground prevents the construction of a channel with a fall adequate to produce the "self-cleansing velocity."

Then—A. The natural fall must be increased by pumping.

B. Or "flushing" must be resorted to, an artifice which depends on the fact, that with streams of similar section the greater the sectional areas, less inclination required to produce a given velocity, or in other words with similar sections and equal inclinations, large streams flow faster than small.

The dimensions and figures of channel being made such as to give the self-cleansing velocity when full the natural flow must be augmented to the extent necessary to fill it, either by collecting and discharging the effluent from some higher district periodically, or sufficient water from some external source must be periodically added to make up the requisite volume.

The choice between these alternatives depends on local circumstances.

The formation of permanent deposit must at any cost be prevented on sanitary grounds.

And it may be safely asserted that, in the vast majority of cases, it will be far cheaper to prevent its formation than to remove it by hand.

ROBERT CHADWICK.

18th September 1882.

APPENDIX II.

Public Latrines.

Typical plans of public latrines.

1. Sheet No. 4 shows three plans of public latrines, in which I have endeavoured to embody the chief principles which, in my opinion, should rule the design of such structures.

General points to be attended to in their construction.

2. The floor and all fittings should be smooth and non-absorbent, wherefore the use of wood should be studiously avoided. There should be no sharp or hidden corners and spaces in which dirt can lodge, and from which it cannot be removed by simply sluicing with water, and rubbing with a mop or "squeejee."

Non-absorbent materials alone should be used.

3. Granite is unsuitable for floors, as the roughness of the surface retains dirt and wet. If punched smooth it is both expensive and slippery. Asphalte is perhaps the most suitable floor covering. Many failures have taken place in its application in tropical climates, but they are usually due to the fact, that an improper quality of asphalte has been used.

Asphalte recommended for floors.

In 1872 I asphalted the floors of the Civil Hospital at Aden, and up to the time of my departure in 1873 it remained perfectly good. The effect of subsequent years may be easily ascertained. The asphalte, in this instance, was supplied by the Val-de-Travers Company, and was prepared specially hard and infusable. Nevertheless, it was easily laid down by ordinary Indian workmen.

Cast-iron plates for floors and partitions of cells which do not come down to floor.

4. Cast-iron plates will probably be the best material for the doors and divisions of the cells. They should be perfectly smooth, all beads or mouldings being carefully rounded off. A space of 6 inches is left between the lower edges of the partition and backs, and the floor or steps, so as to do away with angles and facilitate cleaning. In the first and second designs provision is made for the use of the hose and jet for cleaning, for which purpose no more efficient appliance exists.

Seats not desirable.

5. It must be remembered that Asiatics do not, and will not, use seats. To provide them or anything like them is unnecessary and causes horrible nuisances; I mention this simple obvious fact, for it seems often to have been forgotten. Closet seats have in several instances been supplied for Sikhs and their habit of using water seems to have escaped attention.

Description of Fig. 1. Bucket system.

6. No. 1 shows a modification of the present bucket or tub system, avoiding some of its defects. Boat-shaped vessels of either cast iron, perfectly enamelled, or of earthenware, are substituted for the present wooden tubs, and the form of vessel shown will give great facility for cleaning, and is also well adapted to the reception of excreta.

No. 2. Trough system for water carriage.

7. No. 2 shows a trough latrine, which, of course, pre-supposes the existence of a water supply, and of sewers suitable for the removal of excreta. The trough is sunk in the floor, which slopes in all directions towards it. When in use, it must be kept full of water. From time to time the contents are drawn off by opening the outlet valve, and the trough scoured out and refilled, by means of the pipe at the other end.

The trough is spanned by cast-iron foot plates, on which the user squats, and which are loose and can be easily removed for cleaning. It is most important that the excreta should fall into water, and not on to dry surfaces, to which they adhere, and from which they are removed with difficulty.

The arrangement of the cells in a double row, back to back, is on this account desirable, for it obviates the befoulment of the back of the trough, which usually takes place, and which causes a great nuisance.

Description of No. 3. Canton system.

8. Fig. 3 shows an adaptation of the system which obtains in Canton. Here the excreta fall on to an inclined plane, beneath the movable cast-iron foot plates. They are sprinkled with sand to facilitate the collection and removal of the solids, whilst the fluids run away by the gutter in front; thus complete separation is effected, and the products obtained in the most valuable condition as manure.

In the better class of such places the excrement is removed at once by means of a rake and a basket. In Canton the latrines, though free of charge, are most valuable property. To open one is a privilege, and they compete for the custom of the public. Consequently, they are well kept and wonderfully free from offence. They are usually in open yards, with a small roof just sheltering the cells. I have followed that practice in the drawing.

9. As to the relative merits of these systems. Assuming the existence of a supply of water and of sewers fit for the conveyance of excreta. I consider the trough latrine to be decidedly the best, for it may be kept almost perfectly clean, with a minimum amount of labour and attendance. It seems specially suited for public institutions, such as schools, gaols, native hospitals, and for the barracks of Chinese and Indian police or troops. The value of the excreta as manure is wholly lost.

Comparison of merits of proposed systems. Trough systems most effective where there is water and drainage.

10. The Canton system comes next in point of cleanliness.

It can be worked with the minimum amount of water, and all may be removed by hand, so that it is well suited for places where water is scarce and drains are wanting. It requires much labour and constant attention to keep it in an inoffensive condition. Indeed, in the present crowded condition of the Hong Kong latrines, it seems a little doubtful whether the necessary manipulations can be carried out with sufficient promptitude. Still the advantages offered by it are such as to justify a fair trial.

Canton system effective but it requires much attention but little water. Is almost independent of drainage. High value of products.

11. I would observe that if a supply of "humus" can be obtained, and it be desired to try the dry earth system, the Canton arrangement affords the best possible means of doing so, by using humus instead of sand, applying it somewhat more liberally so as to mix with the excrement. The urine being separated, the minimum amount of dry earth would be necessary.

Canton system would afford facilities for dry earth.

12. As to the modified bucket system it involves all the inherent radical defects of the present system, the improvements merely give the means of carrying out offensive operations in a somewhat less offensive manner, and give increased facilities for cleaning. To keep a latrine of this kind in order a very considerable amount of water for washing receptacles, &c. is required. Drainage is also requisite, and the effluent contributed to the sewers will equal almost in foulness, though perhaps not in quantity, that from the trough latrine.

Modified bucket system remedies some evils, but not all. Water drainage is required.

13. Latrines, when it is possible to do so, should be placed in open spaces, and not hidden away in corners amongst other buildings. They are not picturesque objects, but they are necessary and need not be offensive and are more likely to be kept clean and inoffensive when they are in view of the public than when they are hidden away out of sight in holes and corners.

Positions of latrines.

I am aware that the great cost of land does not give much opportunity for so doing, but where possible open sites should be selected for them.

OSBERT CHADWICK.

18th September 1882.

APPENDIX III.

Notes on Tidal Currents with regard to Position of Outfall.

Position of sea outfall depends on tidal currents.

1. The position of a sea outlet for the sewage of a town must depend on the direction of the tidal currents, and should be such that they remove the effluent as far as possible from the town.

No suitable spot along Praya or to eastward of town.

2. Preliminary observations showed that no advantage was to be gained by discharging the sewage anywhere along the Praya, or to the eastward of the city.

The investigations were, therefore, limited to determining the movements of the currents at Slaughter House, or Belcher's Point, and in Sulphur Channel, which separates Green Island from Hong Kong Island.

Investigations made at Sulphur Channel and Slaughter House Point.

3. The method of investigation was as follows:—Floats were prepared, composed of boards united together at right angles, as shown in the sketch, and ballasted down till a few inches only remained above water. Thus they exposed a large surface to the water, and little to the wind.

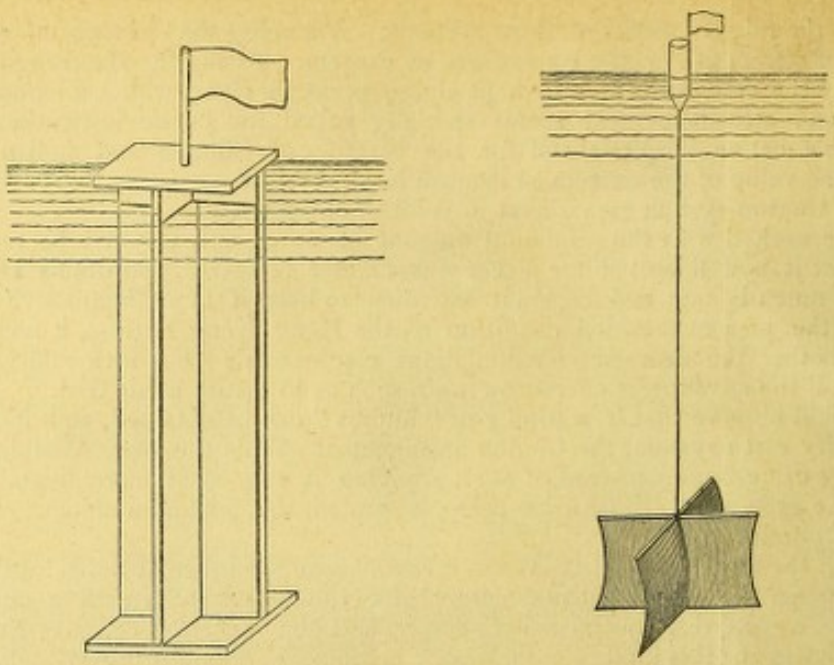
Floats described.

In some cases to ascertain the current at greater depths, and still further to eliminate the action of wind "drags" were used.

These consisted of a light frame of wood, covered with calico, and weighted with lead. This was suspended from a small tin buoy, just sufficient in size to keep the drag from sinking. The area of the buoy being so small in comparison with that of the drag, its movement may fairly be taken to represent that of the layer of water in which the drag was.

Defects of floats too much affected by wind.

4. Though the area exposed to wind by the floats is but small, still it proved sufficient to cause much annoyance, and therefore in future I would recommend, either the entire use of drags, or of floats considerably deeper in the water.



Method of observing. Floats put in at 2 hourly intervals, and subsequent positions determined. Tide gauge recorded.

5. The floats or drags were put in at the points of proposed outfall, successively at intervals of about two hours, and their subsequent positions determined as often as possible during the remaining daylight hours (if they did not run ashore, get foul of shipping, or get stolen). Meanwhile, half-hourly readings of a tide gauge were taken at the Dockyard Pier. These were also continued night and day until my departure to ascertain mean sea level, and to furnish data for predicting the tides for the future.

Method of recording results, reference to tide curves for the day.

6. The results are shown on the drawings, each of which contains a day's work. The coloured lines shows the paths described by the floats, and the figures show the hours at which they occupied the positions indicated by the small circles. The tidal curves for the day is also shown on each sheet.

The path of the float during *rising tide* is shown in *full* lines, that during *falling tide* in *dotted lines*. The successive colours—blue, yellow, and red—show those parts of the path which correspond to periods of rise or fall, marked in the same colours on the tide curve.

Nature of Hong Kong tides. Similarity to tides of Indian Ocean. Semi-diurnal inequality.

7. On plotting the tide curve, from the observations taken at the dockyard, it became apparent that the tides of Hong Kong resemble those of the Indian Ocean, in that the semi-diurnal inequality is great. A large morning tide is followed by a small afternoon tide, or *vice versâ*.

Sometimes, indeed, the second tide disappears wholly, so that there is a rise or fall, lasting for nearly 18 hours.

Observations must be taken in second half of year.

During the part of the year when the observations were taken the morning tide is small, so that observations on the rising tide unduly preponderate.

To complete the investigation, therefore, another set must be taken during another part of the year, when the morning tide is greatest, for I need hardly say that it is practically impossible to make these observations at night. With a steam launch and three guard boats it needed the utmost vigilance to keep all the floats in sight.

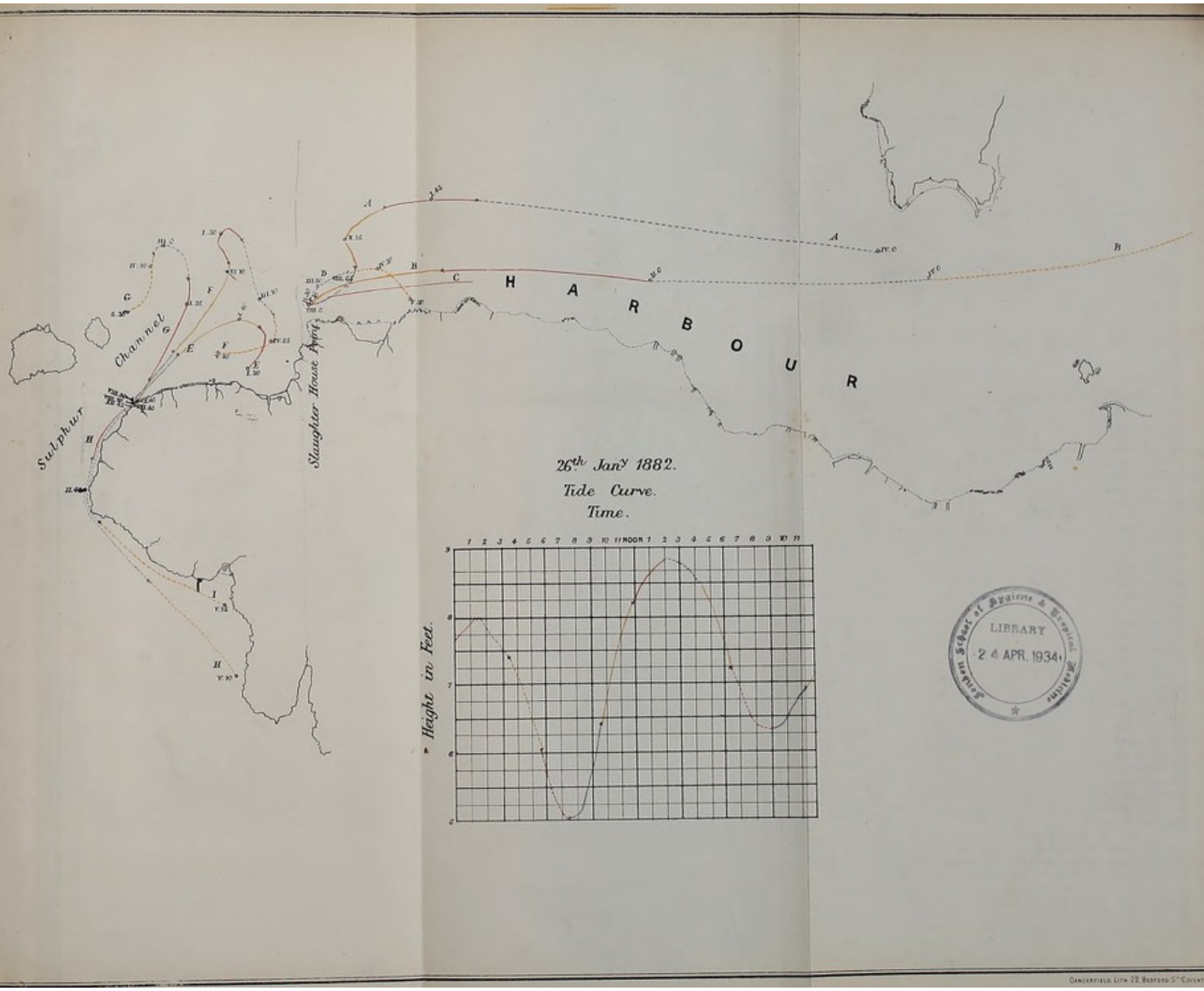
Monsoon will probably be found to have little effect on tides which depend on solar and lunar motions only.

8. I would here observe that the monsoons will almost certainly be found to have little or no effect on the height of the tide (not the surface drift), which depends almost wholly on the relative movements of the sun and moon. Were it not so, the tides of the Indian ports could not be predicted, as they are year after year, within an inch or two as to height, and within a minute or two of time, from these elements alone, and without any regard to monsoons.

It merely happens that the combinations of the sun and moon producing extremely high or low tides takes place during certain states of the monsoon.

9. I have the highest authority for saying that the tides of Hong Kong closely resemble those of the Indian Ocean, and that, like them, they may be predicted with accuracy, and further, that the "elements" for prediction may be computed, with tolerable accuracy, from the observations in my possession.

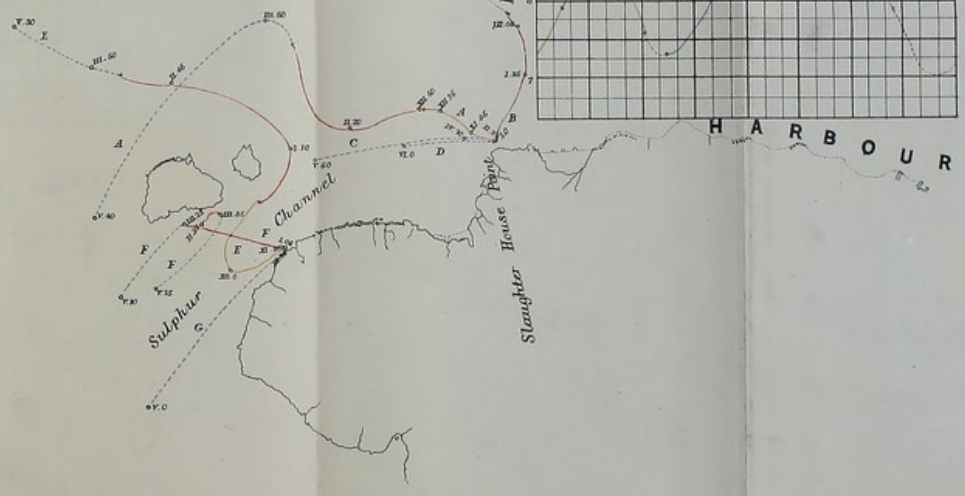
Considering the great value that this information will be, not only to the Government engineers, but to the seafaring public at large, I think it would be most desirable if the Government would incur the trifling expense involved in the investigation of the data and the preparation of the tide tables.


Channel
Sulphur
Slaughter House Point
H A R B O U R
26th Jany 1882.
Tide Curve.
Time.
Height in Feet.
NOON
LIBRARY
24 APR. 1934

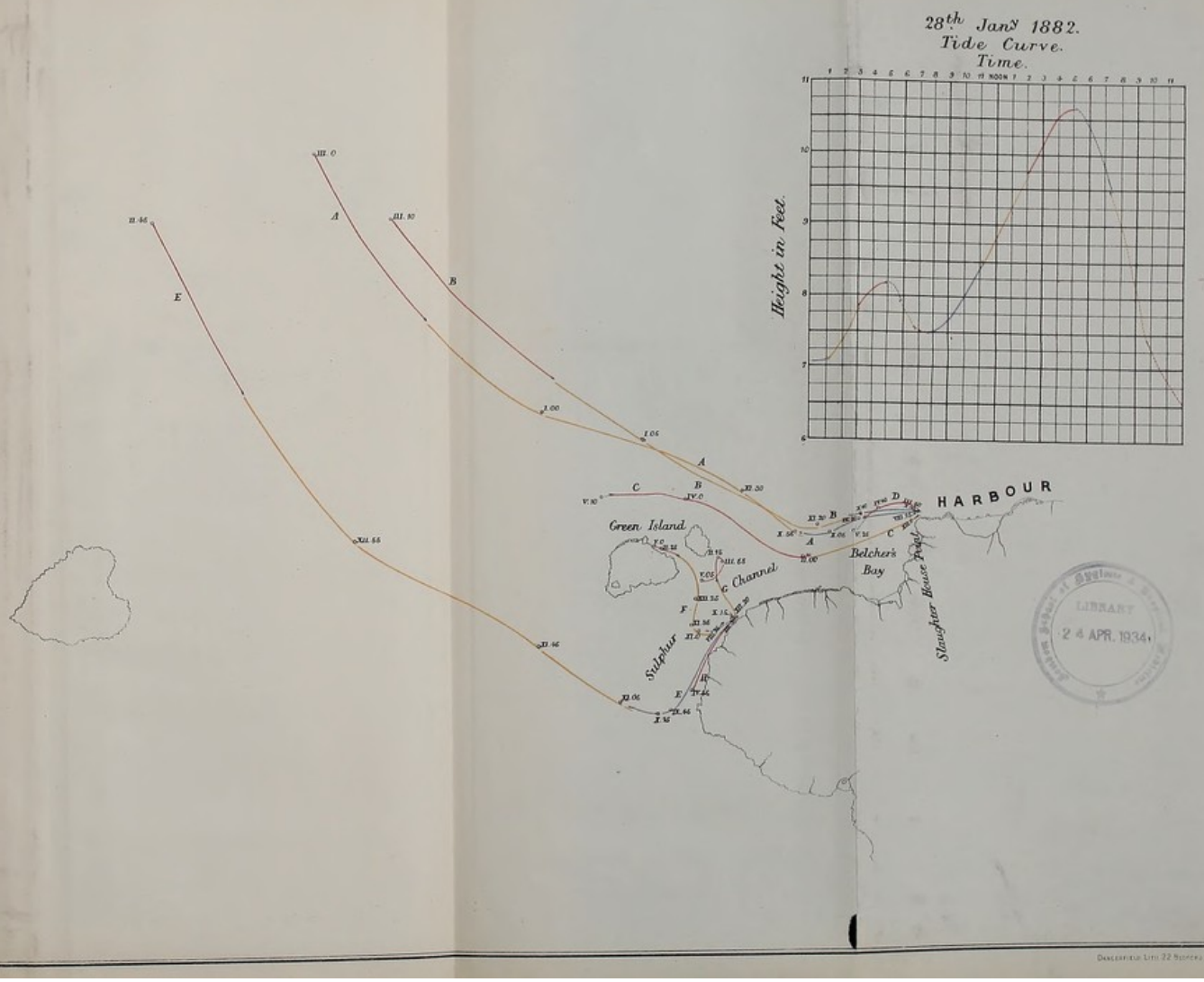
27th Jan.y 1882.

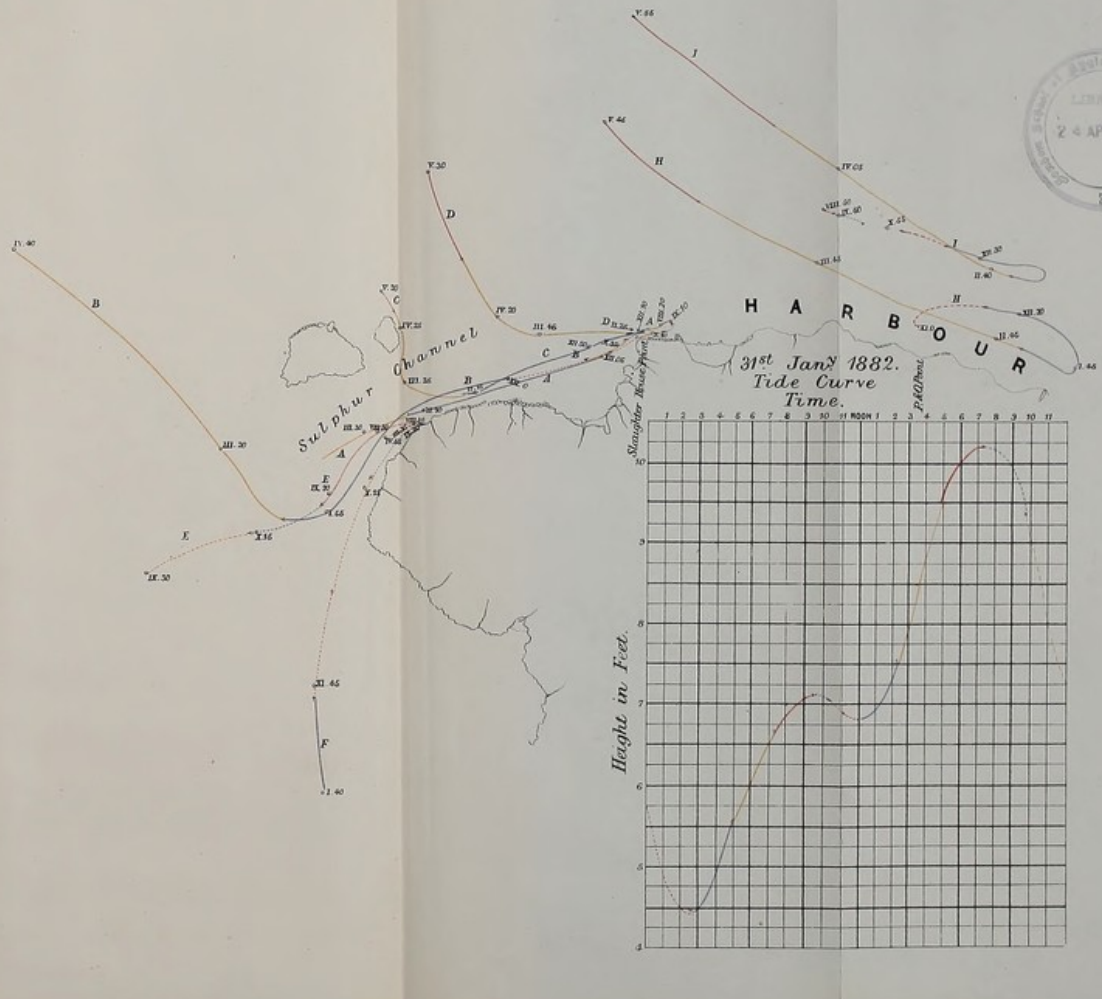
Tide Curve.

Time.



Chromolitho Litho 22 Bedford St Covent Garden





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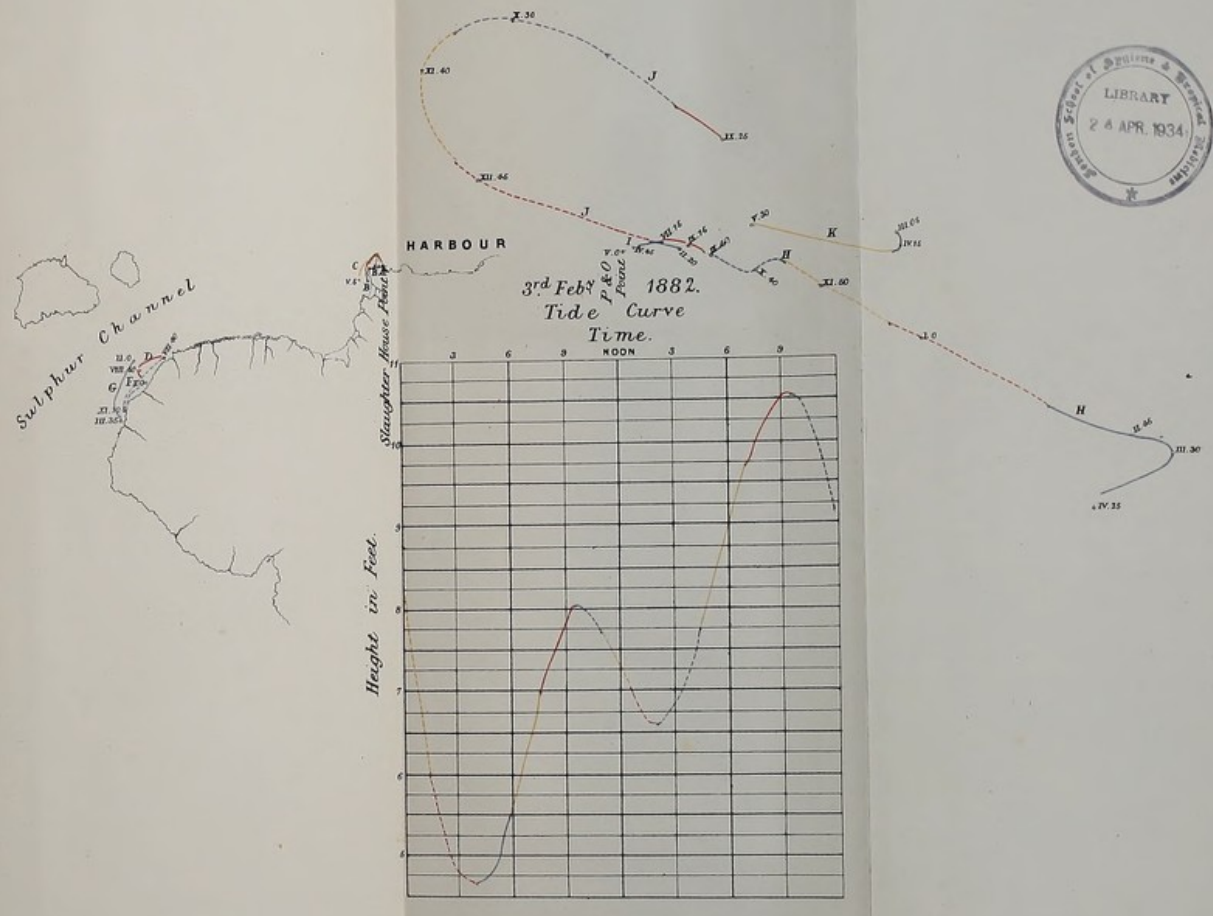
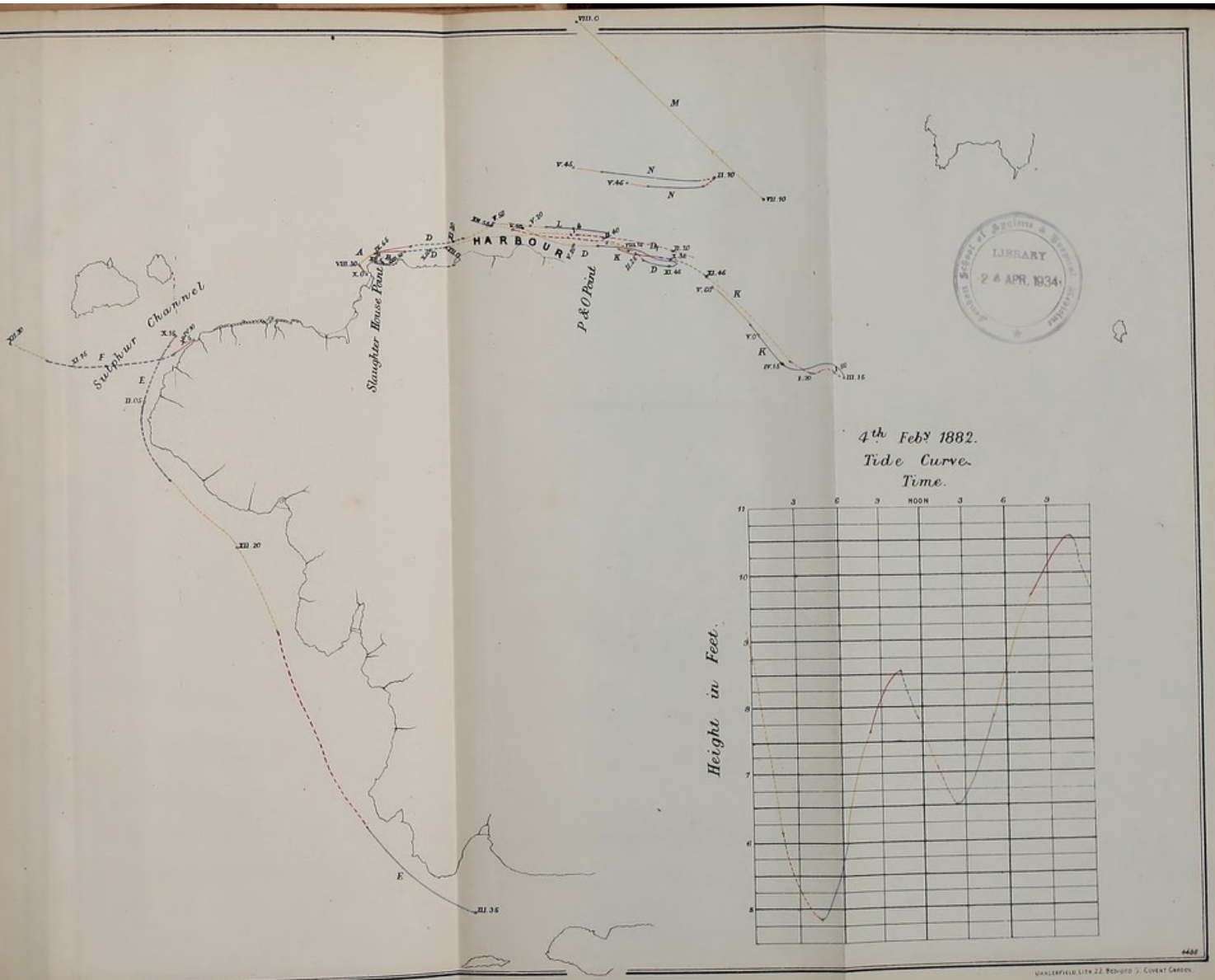

HARBOUR
Sulphur Channel
Slaughter House Point
P&O Point
3rd Feby 1882.
Tide Curve
Time.
NOON
Height in Feet.
LIBRARY
24 APR. 1934



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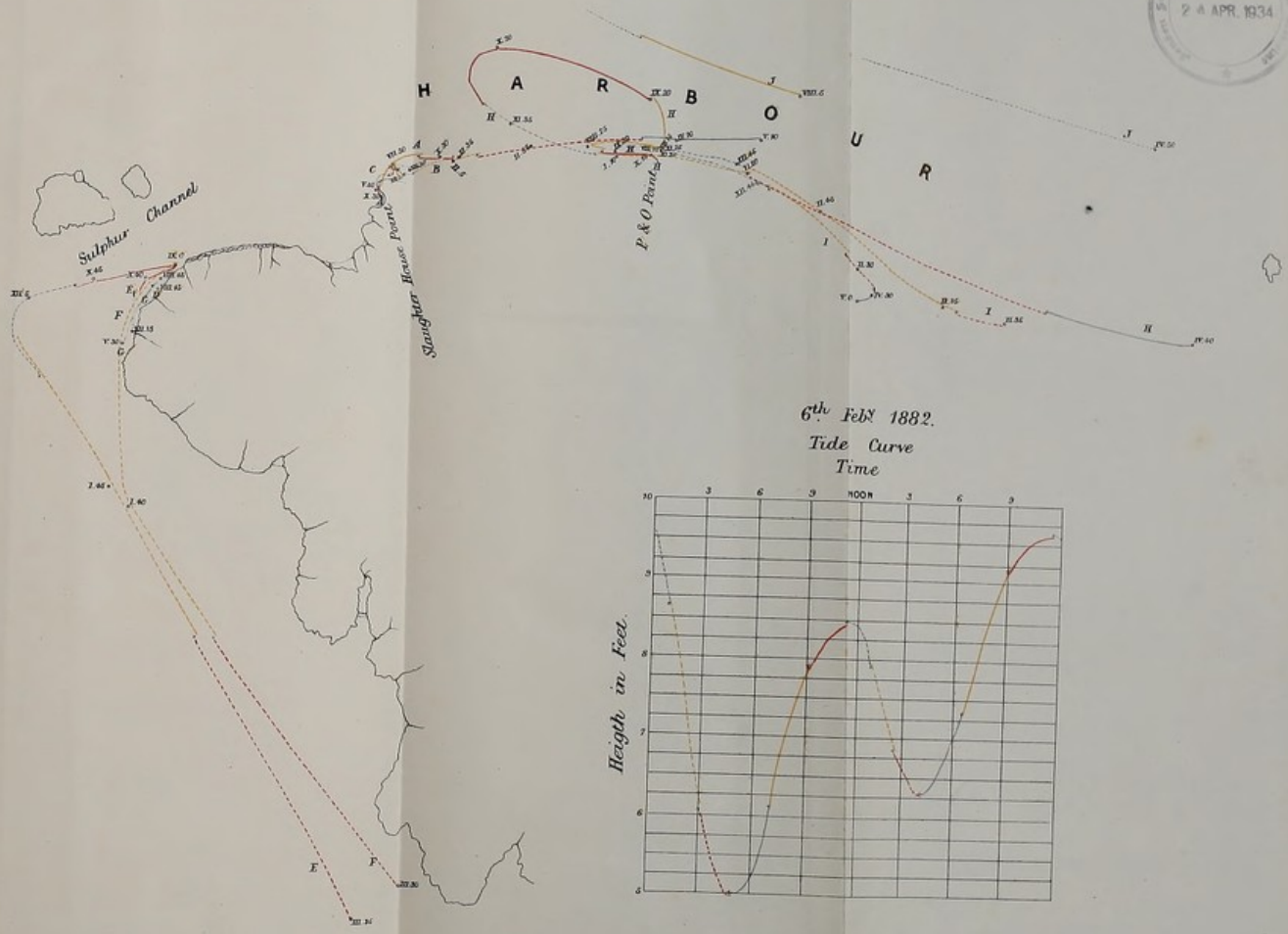
WAKEFIELD LITH 22 BEDFORD ST. COVENT GARDEN.

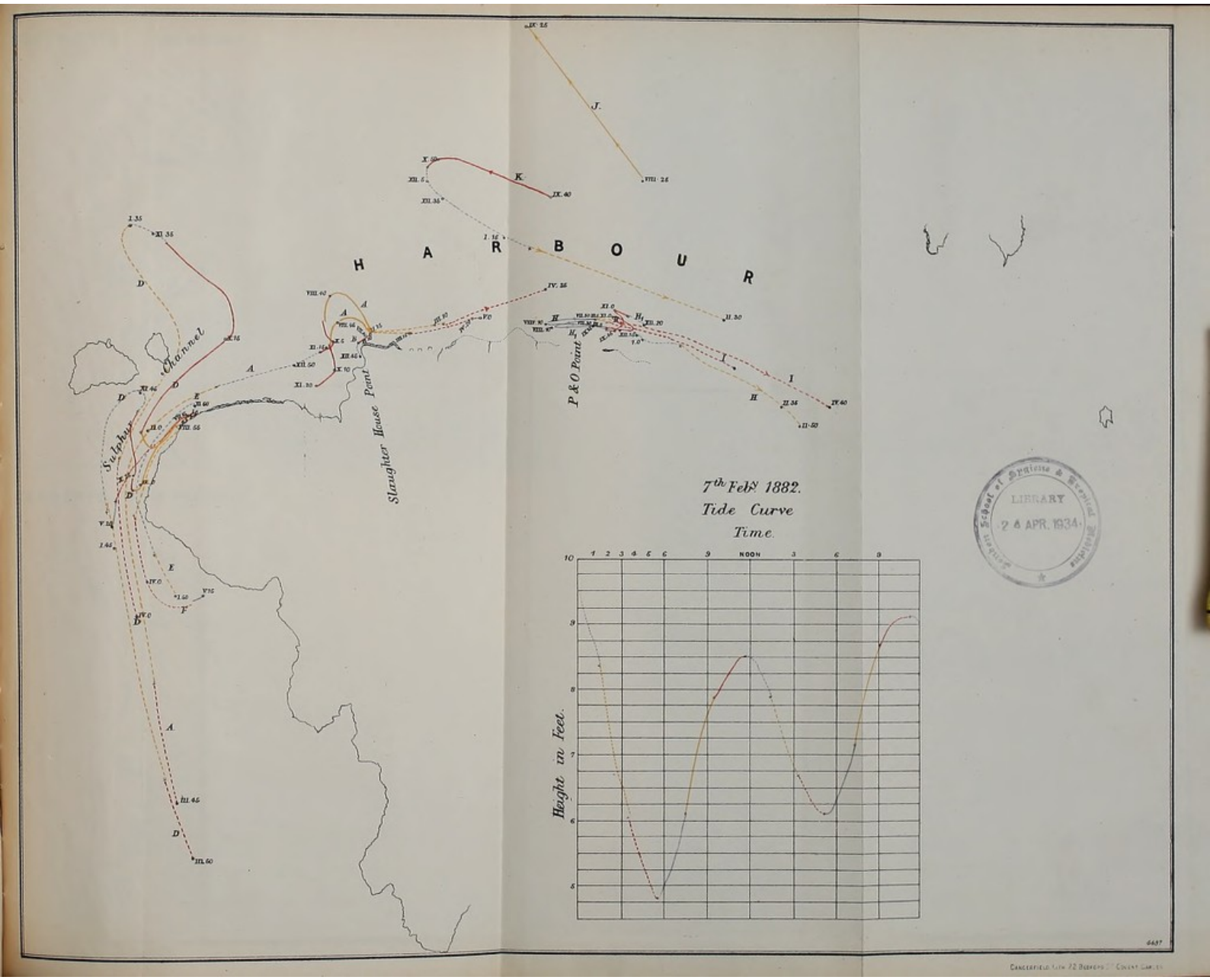


6th Febr 1882.

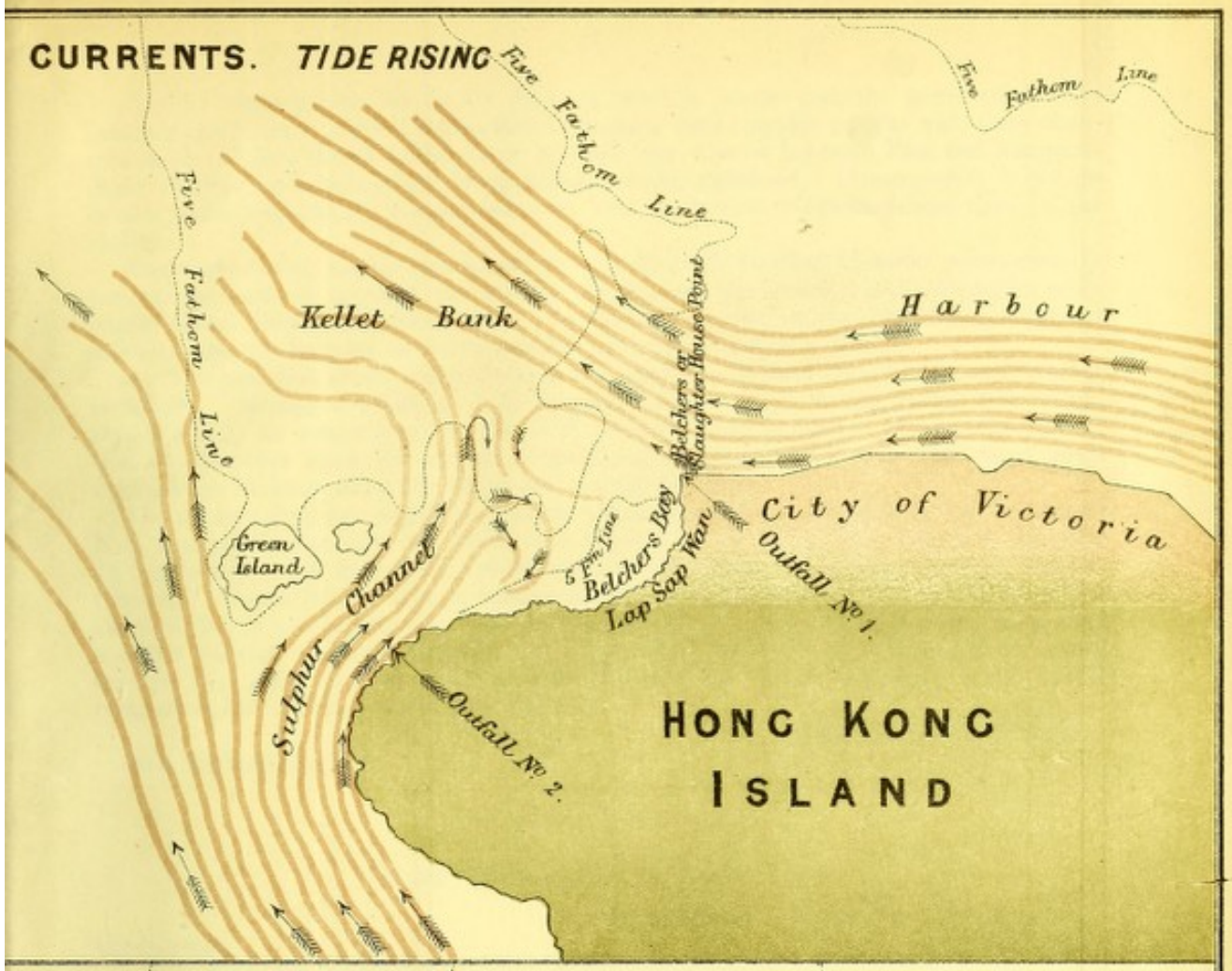
Tide Curve

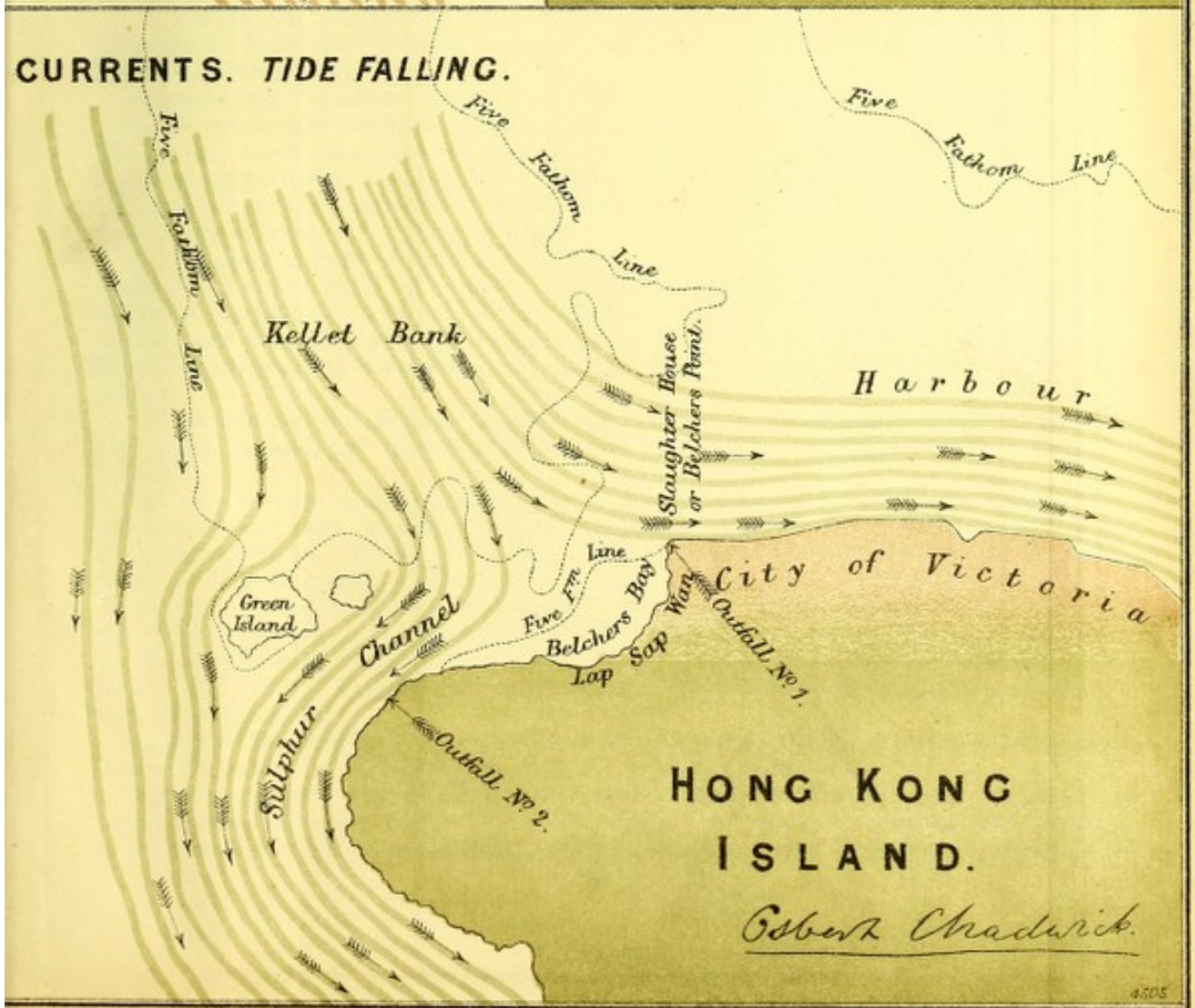
Time

Day & Son Lith. 22 Bedford St. Covent Garden



CANCERFIELD, LITH. 72 BERNERS ST. COVENT GARDEN





DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN

10. The observations, so far as they go, tend to show that the great tidal wave entering the estuary of the Canton River advances more rapidly up the wide deep channels south of Hong Kong Island than through the narrow Lymoon Pass and comparatively shallow harbour between Hong Kong and the mainland. Consequently it is high or low water respectively a little sooner on the south-west of Green Island than in the harbour. General result of observations.

Therefore, during *rising tide* a current sets through Sulphur Channel north-easterly *towards* the harbour, meeting the stream coming up the harbour, and forming an eddy east of Green Island off Lap-sap-wan. On the *falling tide*, on the other hand, a current sets *out* from the harbour, or south-westerly, through Sulphur Channel.

11. The practical result with regard to the question of outfalls is briefly and roughly as follows. Sewage discharged from Slaughter House Point during *rising* tide would almost wholly be swept away to the N.W., and be no more seen. During the *falling* tide, on the other hand, the sewage from Slaughter House Point would be swept down through the harbour along the Praya and among the ships. Practical bearing of results on question of outfall.

The effluent from the outfall in Sulphur Channel on the *rising* tide would be carried N.E. towards the harbour, but would *not* reach it, as it would hang about in the eddy off Lap-sap-wan till high water, when it would be swept away back through Sulphur Channel. On the *falling* tide all sewage discharged in Sulphur Channel would be carried away westward and southward. In no case would any appreciable amount be carried into the harbour or near to the city. It is possible that some nuisance might be caused by filth depositing on the beach at Lap-sap-wan, but the reclamations which are in progress there will tend to diminish this evil.

OSBERT CHADWICK.

18th September 1882.

To the CROWN AGENTS for the COLONIES.

Park Cottage, East Sheen, Mortlake,
July 26, 1882.

GENTLEMEN,

I HAVE the honour to submit, for transmission to the Right Honourable the Secretary of State, the following report on the sanitary questions connected with the barracks at Hong Kong.

I inspected the barracks to ascertain whether there were flagrant defects in sanitation.

On the whole their condition was satisfactory. The latrines are outside the barracks. The sewers, which are completely separate from those of the town, are in fair order, but require more perfect arrangements for ventilation, especially those in Murray Barracks. I pointed out to the commanding engineer these and some other minor defects, and he has, I believe, taken steps to remedy them.

The foreshore in front of the War Department property is flat, and a considerable area is uncovered at low water. Owing to the numerous indentations of the shore line, and the set of the tidal currents, a good deal of filth accumulates here from all parts of the harbour, and not merely from the adjacent property. The sewer of one of the barracks has been carried out to low-water mark, and the other is about to be treated in the same manner.

The mouths of the Murray barrack and Victoria barrack nullas are somewhat obstructed by sand, and there is a tendency to the formation of stagnant pools at their mouths.

The only effective remedy for this state of things, would be to reclaim the foreshore out to low-water mark, or a little beyond it. This would be highly beneficial, both to the town and to the military authorities. The inconvenient interruption to the Praya might be done away with, whilst providing the naval and military authorities with deep-water wharf accommodation and boat cambers, affording far greater facilities for their work than they now possess. It is probable that the advantages which the public would obtain by the completion of the Praya, past War Department property, would be sufficient to justify the Colonial Government in incurring a very considerable proportion of the expense of this work.

I inspected the catchment areas from which the water supply of the barracks is derived. Above the intakes of the drinking supply there were no squatters huts.

It is of course most important that no squatters should be allowed on the catchment basins whence the troops derive their water supply. As to squatters on the other parts of the ground, in their present numbers and positions they cannot be really prejudicial to

health; in greater numbers they would no doubt be so. The only way of avoiding endless disputes about this question would be to mark out once and for all an area, including the catchment areas of the water supplies, on which squatting or building was absolutely prohibited, and if necessary, pass an ordinance empowering the War Department to deal summarily with all within that area. On the introduction of the new water supply it would be well to obtain the barrack supply from the water works. Water derived from a remote and secluded source must always be preferable to that obtained in the immediate neighbourhood of a large town.

Washing of clothes takes place along the courses of the nullas below the intakes. A very bad smell is caused by the putrefaction of the soap-suds in the shallow pools. As I have stated in my general report the remedy for this, is the provision of public laundries.

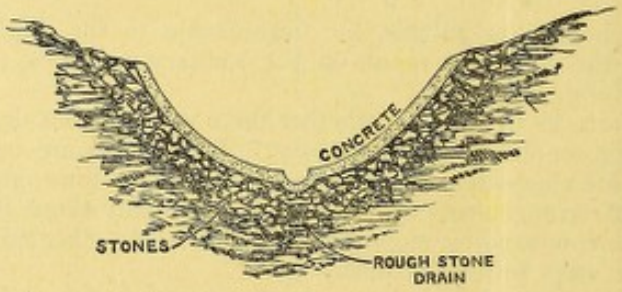
It seems probable that the Victoria barracks nulla, may to some extent be the cause of the inferiority of the health of the troops quartered in them, to that of the troops stationed in the other barracks. The Victoria barrack nulla has only been regulated for a very short distance above the Queen's Road Bridge, whilst that near Murray barracks is provided with a substantial masonry invert and sides, as far as the inland extremity of the barracks.

These nullas serve not only as channels for storm water, but to some extent as subsoil drains also. The moisture in the surrounding land comes to the surface in their beds and sides in the form of springs.

Now the out-crop of sub-soil water, or even its near approach to the surface is a condition favourable to the development of malarious poison.

Coupled with evaporation from more or less stagnant pools, with the emanations from vegetable and other refuse, this makes the nulla a damp unwholesome place and a probable source of disease.

To remedy this state of things and drain off the sub-soil water, before its appearance at the surface I would propose that the Victoria Barracks nulla, should be treated in the manner suggested by Colonel Papillon, R.E., as follows:—The rough boulders in the bed should be broken up, and the rubble resulting from this should be hand-packed so as to bring the bed to a somewhat regular section.



Down the axis of the nulla a rough stone drain should be constructed, and the whole should be covered with a smooth layer or crust of concrete.

Any sub-soil water cropping out from the sides of the nulla would find its way through the dry rubble to the central drain.

Above the concrete sides the ground should be cleared, trimmed, and sloped.

There does not seem to be any positive proof that disease has been produced among the troops by the Chinese houses in Canton Bazaar and other lots in the immediate neighbourhood etched in *black* on plan.

Nevertheless their presence is decidedly objectionable, for in them all the usual defects of Hong Kong dwelling-houses are to be found; over crowding, want of open space, bad drainage and general dirt. They are at any moment liable to become foci of epidemic disease. Even if no direct injury to health can be traced to these houses, still the presence of civil buildings interspersed amongst barracks is objectionable on the ground of good order and discipline. Imperfectly fenced off from the barracks these houses afford facilities for the commission of irregularities, such as the introduction of liquor which cannot fail to be detrimental to the health of the troops.

If the military are to remain in their present position, the best plan will be the purchase of the whole of the lots marked black, by the War Department. Additional accommodation is required for the troops, some of whom are now occupying civil buildings, for which an annual rental of 2,200*l.* is paid, and which are not suitable for the purpose to which they are applied. The saving that would be effected by doing away


PLAZA
CITY HALL
QUEENS ROAD
PARADE GROUND
Murray Pat.
Government Office
Soldiers Gymnasium
Barrack Ct
Lieut. Governor's House
St Andrew's Church
MARGLEY STREET
Main Guard
NORTH BARRACKS
MURRAY BARRACKS
Naval Pier.
Commissariat Pier.
NAVAL YARD
COMMISSARIAT
QUEENS ROAD
Hand Quarter House
Royal Engineers Workshop
Scandal Point
Wellington Battery
MILITARY HOSPITAL
ARSENAL YARD
Military Stores
VICTORIA BARRACKS
PARADE
VICTORIA BARRACKS ROAD
Magazine

with hired barracks together with the sums obtained by the sale of the detached portions of War Department property, Spring gardens and Brook cottage would greatly reduce the cost of the purchase, and the remaining expenditure, would be amply justified by the advantages gained.

Should this purchase be impossible, then I would suggest that a complete separation should be made of War Department from civil property. An alley should be made along the boundary, at the backs of the houses, the War Department ceding any land that might be required for the purpose. The alley when formed and properly paved, should be handed over to the civil government, with an understanding that they should scavenge it, and maintain it unobstructed, as a public thoroughfare. All division of authority will then cease. The Commanding Royal Engineer is preparing estimates for the work.

The sanitary condition of these houses should be improved in the manner described in the general report. No better place could be found for the first application of sanitary improvements to dwellings, and to the remedy of defects which have been described in the general report. The work should be done, here at least, at public expense. The local experience acquired in the complete sanitary improvement of one or more blocks, will amply repay the expense of the work. It is worthy of consideration also, whether, provisionally at least, these blocks might not be placed under special regulations compensating the owners, if necessary, for disturbance of vested interests.

The consideration of the question of removing the troops to a site on the east of the town does not perhaps form part of my duty. I may, however, be permitted to record an opinion that the proposed site does not appear to offer any considerable sanitary advantages. It is subject to the general disadvantages that it is under the lee of the mountain during the south-west monsoon, and therefore, like the rest of the town, close and oreezeless during the hot season. It is also intersected with deep, damp, and rugged ravines.

If the troops are to be moved the best position for them would, in my opinion, be on the Kowloon Peninsula, where there is more room and air. The malaria evolved by movement of the soil would be an evil common to both sites, and would after a time disappear. Careful subsoil drainage and sewerage would prevent any subsequent production of malaria.

There can be little doubt that Kowloon is more airy and cool than Hong Kong, and there would be more space for drill and recreation, both important factors in the health of troops.

I have, &c.

To the Crown Agents for the Colonies.

(Signed) Osbert Chadwick.

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