Yellow fever, Bermuda : historical sketch, abstracted from returns to Parliament, 20th December 1854, 17th February 1858, and 4th August 1866.

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Yellow Fever

YELLOW FEVER.

BURMUDA.

YELLOW FEVER, BERMUDA.

Historical Sketch, abstracted from Returns to Parliament, 20th December 1854, 17th February 1858, and 4th August 1866.

EPIDEMIC OF 1853.

1. Great rain, with heat and calms, prevailed in the summer of 1853. Fever in excess prevailed in the West Indies and in America in consequence.

2. On 6th June 1853, Dr. Hall reports severe dysentery among the convicts, and predicts much sickness. On the 9th July a convict died of fever, and the usual hot season fever was being developed.

3. Before 29th August 120 cases occurred in the hulks at Ireland Island, and in the prisons at Boaz Island.

4. Cases of yellow fever occurred among the troops at Ireland Island in the latter part of August. The two first cases, one on the 27th and one on the 28th, both recovered. But a fatal case of dysentery, merging into fever, occurred on the 14th July.

5. During the epidemic, out of 419 persons belonging to the naval yard, 29 cases were admitted and none died. Seven of the cases were yellow fever. This remarkable result is attributed to absence of overcrowding and vigilant sanitary precautions. There were five cases and two deaths among 34 persons living in the hospital. During the epidemic 131 cases were received into the hospital at Ireland Island and 39 died. The epidemic continued until the middle of September.

6. The first case among the civil population occurred in a boy, nine years old, at St. David's Island. He died on 2nd August.

7. Several presumed channels of importation were advocated, but on inquiry by the Commissioners none were substantiated.

8. The following striking coincidences occurred:

On the 20th August a gale of wind parted the "Thames" hulk at St. George's from her moorings, and occasioned great nuisance in the Royal Barracks by stirring up the mud. On the 21st a Spanish war ship arrived from the West Indies. She had no yellow fever on board. She remained till the 30th and was visited by officers of the garrison, one of whom was attacked on the 4th September, and recovered. Six other officers who had been on board were attacked, and several died. Many other persons who went on board did not suffer. This would have been considered as a case of importation had it not happened that on the day on which this Spanish ship arrived at St. George's there were already 34 sick on board the hulk.

The first cases which occurred among the civil population of St. George's were on the low ground at the foot of Barrack Hill, close to the muddy beach where the hulk was moored. From this it "crept up the hill" to the barracks.

9. After the 5th September the troops were gradually removed from St. George's and the Artillery Hospital was evacuated. These measures had the most beneficial results.

10. Removal to Tucker's Island was also attended with diminution of disease, partly from enforced sobriety. Troops encamped at Prospect Hill and in Devonshire Parish, also at Gibb's Hill and Mount Langton telegraph, escaped the fever.

11. The following are the statistics of the fever.

TROOPS.

		Strength, 1st July.	Deaths to 31st December.
Royal Artillery	Officers	5	3
	Men	156	48
Royal Engineers	Officers	5	2
	Men	94	25
56th Regiment	Officers	18	6
	Men	1,016	222
	Total	1,294	306

	Strength, 1st July.	Deaths to 31st December.
Women	66	29
Children	157	19
Officer's Wives	-	4
		52
Commissariat Officers		1
„ Men		2
		3
Total deaths		361

Native Population.

Strength	11,092
Deaths	138

Convict Establishment.

Strength of Officers	116
Deaths	9
Strength of Convicts	1,662
Deaths	152

12. Mortality at St. George's among the troops was dreadful, especially among officers and servants, attributed to bad accommodation and want of ventilation.

Sanitary state of St. George's itself defective, and much mud in the anchorage.

13. The experience of this epidemic points out the advantage of avoiding overcrowding, and of not placing large bodies of men together in the same building, efficient ventilation, and great cleanliness.

Local Causes.

Town of St. George's in a very bad sanitary condition as to drainage, cleansing, and water supply. The beach at the foot of Barrack Hill "disgusting and offensive from all sorts of refuse."

A very offensive smell from part of the Lagoon at Ireland Island. Several men of the 56th on duty there were attacked. Stench from privies in St. George's insupportable. The whole place subject to endemic attacks, and dangerous as a residence for non-commissioned officers and their families. Filth and salt water mingle in the subsoil of the town.

The following was the cubic space allotted in barracks at the time of the epidemic :—

St. George, 377 to 409 cubic feet; Ireland Island, 288 to 380 cubic feet.

Personal Causes.

Intemperance.
Idleness.
Want of occupation.

Opinions as to Barracks and Hospitals.

Artillery Hospital.—Bad.
Fort Victoria.—Not fit for habitation in such a climate.
Fort George.—Double the number of men were placed in it that ought to have been.
Royal Barracks.—Half of the men should be removed out of them in the hot weather.

Ireland Island.

An official examination of Ireland Island showed open drains with night-soil in them, foul privies, pig-stys, filth and filthy houses infecting the air around, water in the tanks charged with sulphuretted hydrogen so as to be undrinkable, gas actually escaping from some tanks, tanks under floors of houses, and foul water escaping into them. Examiners actually recommend that the tanks be ventilated, to enable the sulphuretted hydrogen to escape. They also recommend tubular drainage and water supply for waterclosets; privies and cess-pits to be abolished.

Mr. Anderson, civil engineer, states that the cubic space per man at Ireland Island was 290 feet in the ground floor of the casemates, and that each alternate room on the upper floor had a well staircase communicating with the room below.

A privy for 300 men is over a hollow shaft 24 feet by 4 feet and 50 feet high, communicating with an open ditch, and diffusing pestilential gases. In this way the whole surrounding atmosphere is affected, not only in the barracks, but in the naval yard.

The account given by this witness of the sanitary state of the towns is such as to excite surprise and indignation. No one sanitary appliance of any kind; every house has its cess-pit; the subsoil impregnated with human filth; intramural graveyards, from which poisonous and offensive gases proceed. He states his conviction, founded on experience, that sanitary works and measures would remedy the unhealthy state of the island. He considers the barracks in Ireland Island, in their present state, as unfit for occupation.

The following is the account of two other barracks given by Colonel Oakley:

"The occupation of either Fort George or Fort Victoria by troops is, in my opinion, "wrong. They are damp, and consequently unwholesome; added to this, the privies "emit a stench perfectly sickening, and the whole atmosphere is tainted by it. They are "likewise overcrowded; and overcrowding, combined with horrible smells, must affect "troops or anything else unfavourably."

He says that the Royal Barracks are well situated, except that foul air must reach them from the town.

FEVER OF 1856.

The Yellow Fever of 1856 was an endemic, attacking certain localities only, and leaving one of the worst unaffected. The following were the attacks and deaths among the troops:—

26th Cameronians.

Total strength	1,052
Attacks (1 officer)	35
Deaths (1 officer)	2

Royal Artillery.

Strength	125
Attacks	2
Deaths	Nil

Royal Engineers.

Strength	8
Attacks	Nil

Storekeeper.

Strength	17
Attacks	Nil

Commissariat.

Total strength, including women and children	53
Attacks	5
Deaths	1

Convict Establishment.

	Strengh.	Attacks.	Deaths.
Officers	126	28	5
Convicts	984	106	22

Civil Population.

Numbers in seven affected parishes	8,107
Deaths	107

The conditions which appeared to predispose to the epidemic in 1856 are stated to have been:—

1. Unusually low tides, leaving the beaches with great quantities of putrescing refuse exposed to the sun. They propose to remedy this by sanitary works.
2. Uncultivated, unreclaimed, but perfectly reclaimable marshy land, giving rise to intolerable nuisance.
3. Absence of all sanitary works. People spending money on cedar-wood for fumigation, which ought to have been spent on cleansing.

Description of Sanitary Condition of Bermuda, abstracted from Returns sent from Bermuda to the Barrack and Hospital Improvement Commission.

The Bermudas are a chain of islands 17 miles long. Greatest breadth of land two miles. Average breadth less than a mile. Geological formation partly coraline, partly soft calcareous sandstone, with red earth in valleys; aspect hilly, rising to 200 feet above the sea; coast deeply indented with bays and lagoons, which have been gradually shallowing and filling up so as to become offensive and unhealthy. A considerable extent of reclaimable marshy land; no streams. Water for troops obtained from rain-fall collected in tanks. Those at St. George's, where there is accommodation for 613 non-commissioned officers and men, contain about 380,000 gallons. At Fort Cunninghame there is tank space for 11,000 gallons (24 men). At Ireland Island 257,817 gallons for 258 men. The total tank capacity for these barracks is, hence, under 650,000 gallons for nearly 1,000 persons, including officers, servants, &c., or less than two gallons a day each.

Well water can be obtained, for there are naval wells which yield an inexhaustible supply.

The annual rain-fall over four years was about 44 inches a year. From one-fourth to about one-half of the days in each month are rainy.

The following table gives the statistics of barracks :

Name.	Height above sea.	Number of men.	Number of rooms.	Cubic feet per man.	Superficial feet per man.
Fort Victoria	146 ft.	142	15	567	55
„ Albert	101 „	22	3	535	65
Sappers	97 „	53	3	508	50
Royal	85 „	278	12	512	50
Western	114 „	49	5	514	55
Fort Catherine	47 „	16	2	553	60
„ George	153 „	53	5	522	60
„ Cunninghame	65 „	24	1	505	36
„ Hamilton	15 „ (hired house).	—	—	—	—
IRELAND ISLAND.					
Casemates	54 „	222	12	489	50
Artillery and Engineers	40 „	62	7	500	50
Bastion 11	53½ „	14	2	480	60
Ravelin Tower	—	22	2	424	50

The number of cubic feet per man is that allowed by last Horse Guards letter. The superficial area is an approximation only.

CONSTRUCTION OF ROOMS.

FORT VICTORIA.

A casemated building, shaped like a ship with the prow cut off. It is divided into three floors of rooms. The men's accommodation is in the two upper floors. They are all below the level of the ramparts, from which the block of building is separated by a ditch 10 feet wide. The officers' rooms are also on the upper floor. All the rooms in each floor communicate by openings in the arches, and also with the rooms below, by staircases. Rooms vary in length from 41 to 58 feet. They are all 10 feet broad, and from 10 to 12 feet high.

Each of these long rooms has a single window at each end.

Ventilation, said to be sufficient, although there are no special means, except openings stated to be over the upper floor windows but not shown in the plans.

So far as health is concerned this fort presents a very unfavourable specimen of barrack construction, and is certainly unfit for permanent occupation.

Drainage.—None, properly so called. The cook-house refuse water is turned into a cess-pit in the ditch, and allowed to sink into the ground close to the walls of the fort. The water from lavatories is conveyed to the soldiers' privy at Fort Albert.

The latrines are placed directly over a sloping drain leading to a cess-pit emptied in winter. The contents are buried. These cess-pits are in the outer ditch only a few yards from the nearest tank.

FORT ALBERT.

This is a square fort in two floors. It has one long narrow barrack-room 45 feet by 10 feet 9 inches and 10 feet 6 inches high on each floor, and one small room half the size.

The basement floor has three windows along the side of the room and three loop-holes at one end. On the upper floor there is a window at each end, 45 feet apart. All the rooms and also the kitchen communicate. This structure is not so bad as the former, but it is only fit for temporary use.

Ventilation.—The windows are casements, closed at night. There are no fixed means of continuous ventilation.

Drainage.—None, properly so called. The privies are over an open drain leading to the sea, and occasionally flushed from a cistern. One privy is over a cess-pit within the fort.

Water is supplied by hand from a tank within the fort. The tank is 26 yards from the cess-pit.

SAPPERS' BARRACK.

This barrack consists of three rooms or huts, two being of wood. It is in a dilapidated condition, and its removal is said to be in contemplation. It has windows and doors, but no other means of ventilation, and at night, when the windows are shut, the ventilation is insufficient. There are no lavatories.

Drainage.—None. All surface water is led to a cess-pit and allowed to percolate the subsoil. The privies are placed over a cess-pit, 30 yards from the nearest tank.

Royal Barracks.

These are situated on the top of the hill above St. George's, and the smell from the town sometimes reaches them.

They consist of a range of one-storey huts with doors and windows at each end, and about 42 feet apart. The huts are so arranged side by side that one division wall answers for two adjacent huts, and as the walls are pierced by openings, the whole barrack is nothing but a long, narrow, badly-constructed room for 278 men. It is an aggravation of all the bad parts of Indian barracks.

Ventilation.—The windows are casements and do not open at the top. There are no means of ventilation when the windows are shut, except six circular openings, each 2½ inches in diameter, for 19 men or more. It is not sufficient. There is ventilation underneath the floors of the barrack.

Drainage.—The drainage from ablution rooms and cook-houses is led to the privies.

Water is supplied by hand. The privies are over a drain connected with the sea. The arrangements are very bad and quite unsuited to the climate. There are other privies over cess-pits emptied by contract. It is stated that the vitiated state of the air in the men's rooms from overcrowding has doubtless been a cause of disease and mortality.

Officers' Quarters.—These are small back-to-back rooms 15 feet by 11 feet, and without any thorough ventilation. It is suggested that two rooms should be thrown into one.

Western Redoubt.

This fort is a three-floored casemated building of the same construction as Fort Albert, except that the men's rooms are in the centre of the block. They are 52 feet 6 inches long and 16 feet wide, and have two windows at each end.

Ventilation by windows, which are casements not opening at the top. No other means of continuously changing the air. There are no ablution rooms.

Drainage.—None. The privies are over a shaft connected with a cess-pit into which all refuse water is passed. It is emptied in the winter. This soil-pit is 30 yards from the tank on a lower level.

Fort Catharine.

This is a small fort, having two small barracks-rooms built in it. Each room has two windows at one end, and one window at the other. The upper parts of the windows open separately. There are no other means of ventilation.

Drainage.—None. Refuse water is thrown out upon the glacis. There are no lavatories. The privies are over a cess-pit, which apparently extends under the floor. It is cleared out occasionally.

Fort George

Is a casemated work, nearly cubical in form, and containing three floors of rooms of various kinds. There are two long barrack-rooms in the centre of the mass of the building. They are each 53½ feet long, and have two windows at each of the opposite ends. There are also two or three small square rooms. The ventilation of all the rooms is common throughout the building.

Ventilation.—By windows consisting of casements; there are no means of opening the upper portions, and the ventilation is insufficient.

Drainage.—None. All refuse water percolates the subsoil. The privies are connected with a cess-pit.

Fort Cunninghame.

The barrack in this fort consists of a single hut building, at one end of which is a single room with windows on opposite sides, and a door at the end. The construction is simple enough, and the floor is raised above the ground.

Ventilation by means of windows only, which appear to be casemated, not opening at the top. There are no separate means of renewing the air, and the ventilation is insufficient.

Lavatories.—None.

Drainage.—All waste water is conducted into a cess-pit, and allowed to percolate into the subsoil. The privies are over a drain to the sea. The barrack holds 20 men. The sewer outlet for a privy for this number is extravagantly large, viz., 5 feet by 2 feet.

Ireland Island Barracks.

Casemates.—This building is in two floors, and consists of casemated rooms 50 feet long by 16 feet wide, running from front to back of the block. Each room has four windows, two at each opposite end, so that the rooms as regards light and ventilation are 50 feet wide. Along one side the wall of the fort is 12 feet 10 inches from the windows, and it rises to the height of 25 feet, that is, two or three feet above the level of the top of the windows on the upper floor. All the men's rooms on each floor are connected by passages through the division walls, and two of the staircases pass directly from the rooms below to the rooms above, so that in reality the whole block consists but of one barrack room so far as concerns its ventilation.

Ventilation.—On the upper floor there are 6 feet of space in each room above the level of the top of the windows. There are small openings under the crown of the arches to admit of the escape of foul air at this point. The windows are sashes, opening at the top. The ventilation at night is insufficient.

Drainage.—All the drainage and waste water are conducted by surface drains to the privies. These are placed over drains running to the sea, and there is a cistern for flushing the drains.

Commissioners House.—Royal Artillery and Engineers.

This appears to be a large private house occupied by officers, men, and married people. The rooms are of the usual description of those in private houses. Corner rooms have windows on two sides. Rooms in the faces of the building have windows on one side.

Ventilation by windows only; part of them open like casements, part open top and bottom. The ventilation is not sufficient.

Drainage.—All drainage is conducted to the privies and so to the sea. The privies are over an open drain. There is a single cess-pit for waste water, about 12 yards from the nearest tank.

Bastion H.

This is a small casemated barrack on a single floor consisting of two arches 25 feet long, 14 feet wide, and 10 feet 9 inches high. Each room has a window at each opposite end. The only ventilation is by windows, and is insufficient at all times.

Lavatory.—None. The privies consist of two seats over an open drain, communicating with the sea. The building is very damp, owing to percolation of rain and deficient ventilation.

Ravelin Tower.

This is an angular-shaped casemated work in two floors. There are two men's room on the upper floor, each 26 feet by 15, and 13 feet 6 inches high to the top of the arch. Each room has four loop holes opening on either side of the angle of the Ravelin, one embrasure on the side and a door with two windows in the rear. The rooms communicate by a doorway in the pier of the arches.

Ventilation.—There are no separate means. The windows are casements, and when shut, the ventilation is insufficient.

Lavatory.—None.

Privies.—None.

Drainage.—None, except into the rock. Building very damp from infiltration of roof-water.

Hospital.

The hospital appears to be situated in a healthy position close to the sea, and about 20 feet above its level.

It is a two-floored building resting on a basement used for stores. Its general construction is similar to that of our new regimental hospitals; that is, it consists of a centre and two wings. In the centre below are placed the two stewards' rooms, and two surgeries, one for each regiment. In each wing below is a ward 27 feet 6 inches long by 21 feet wide and 10 feet high.

On the floor above the whole space is occupied by two wards, each 40 feet 6 inches long, by 21 feet 8 inches wide and 12 feet 6 inches high. Over the projecting part of the centre are three small wards, all communicating with ~~either~~ each other, and with the two larger wards.

Outside the wards, at each end, is a watercloset, supplied with water by a force-pump. The building is surrounded by a verandah.

The whole building would hold 24 beds at 1,500 cubic feet per bed. The Horse Guards letter of 17 August 1858 authorizes 48 patients at about 750 cubic feet each.

Ventilation.—The windows open top and bottom, and there are openings in the ward walls both above and below.

In many of the usual arrangements this hospital is very deficient.

General Conclusions as to the Causes of Yellow Fever.

These islands consist of coraline rock, and also of a soft porous calcareous sandstone, overlaid at various places with rich soil. The whole appears to form a porous spongy mass permeable by the rain above, by the sea below, and by any fluids thrown on its surface.

There are several lagoons in which the water moves sluggishly, and there are numerous creeks along the line of coast, into which decaying matters are drifted so that the heads of many of these creeks are becoming shallow, and filled up with refuse matters, mud and sand. Connected with this are the small rise and fall of the tides, and the high temperature with moisture. The tides are from 4 feet to 2½ feet.

There is besides a considerable extent of marshy ground in various parts of the island.

The islands themselves are generally considered healthy, but the conditions above stated have an injurious influence on the purity of the air.

Under a complete system of drainage and conservancy, including the cultivation of waste ground, the cleansing of creeks, &c., there should be nothing specially to cause fever; but without the requisite exertion and work it is probable that persons landing for the first time on the island would be to a certain extent exposed to febrile miasma, under the topographical conditions described above.

In order to sustain a population in health, the nature of the soils, the temperature and humidity of the air, and the topographical peculiarities, would all require to be taken into account.

It appears, however, that the towns have been built in almost the worst, if not the very worst, sites the Islands afforded.

St. George is on the margin of a lagoon, with a filthy beach in front of the town, and a high hill directly behind it.

Hamilton is situated near the head of a creek.

In laying out the towns proper attention has not been paid to considerations of health. They are closely built, with bad streets and lanes, not well kept. There is no drainage. The soil is so porous that the sea-water passes under the houses, and instead of providing against the bad effects of this by an efficient system of drainage, the people have actually dug cess-pits, one for each house, into which all the filth and foul water pass, and mix with the sea-water in the rock below, just as if it was intended to try the production of fever by a chemical experiment on a large scale. If such experience were ever wanted, this is the very way in which it would be sought.

There is no water supply except what is obtained from the rain-fall on the roofs, collected in water butts and tanks.

There are some wells dug in the foul subsoil, which are used by the poorest part of the population.

The state of the drainage and cleansing and the condition of the beach are quite sufficient to account for the nuisance experienced in the barraks above, and also for the periodical outbreaks of yellow fever in the town.

It appears that the dead are buried close to the dwellings in such a situation as to add to the impurity of the subsoil water; and in one instance the drainage flowing out at low water, appears to have polluted the sea margin. The same occurrence appears also to take place from the cesspool drainage finding its way on to the surface of the beach.

There appears to be sufficient evidence in the papers referred to, to account for the predisposition to yellow fever among the civil population, who must always be either under the disease or becoming prepared for it.

The whole of this part of the subject requires a specific inquiry; but it is the key to the question, for so long as the inhabitants are subject to fevers, the troops can never be considered safe.

In the epidemic of 1853, the condition in which the convicts were barracked on board

close ships, in still water of no great depth, resting on foul putrid deposit, all the excreta of these convicts being thrown into the water, would sufficiently account for yellow fever amongst them. Fixed hulks situated in these creeks and lagoons were not places where prisoners should have been placed. Their presence, under such circumstances, added to the general fever susceptibility.

If epidemic yellow fever were imminent, the troops would be under the influence of any general predisposition, which would be ready to be called out by any adequate collateral cause. That there were adequate causes is shown from the following:

1. Troops cannot be barracked with safety to health in malarial climates, on sites exposed to foul air.

The Royal Barracks at Bermuda occupy such a site, overhanging the foul town and beach of St. George's. There appears to be plenty of healthy ground not so exposed, and close at hand.

2. In such climates it is unsafe to health to mass men together in large numbers under one roof, and still more so in large rooms, and yet there are three barracks, the Victoria, the Royal, and Ireland Island Casemates, containing 142, 278, and 222 men respectively; the barracks being so constructed that not only are the men under the same roof, but they are all really in the same room, because all the rooms in each barrack communicate directly with each other by doors, windows, and stairs.

3. As regards overcrowding and bad ventilation, the table before exhibited shows that the men have some of them one-half, some of them one-third only, of the cubic space required for health in warm climates. As regards ventilation, all the larger casemated barracks have a most insufficient amount of external movement of the air, as they are all sunk in wells formed by the defences, and not one barrack is properly ventilated.

As defensive works these forts are probably very good, but there is hardly one room of them in which several men should sleep constantly.

In short, the barrack construction is the reverse of that recommended by the Barrack and Hospital Committee for India.

These forts, in such a climate, should not be reckoned as barrack accommodation in time of peace.

The poisonous effects of privy gases during epidemics are well known, and it appears that they pervade the atmosphere about many of the barracks. Most of the larger barracks appear to have drains of some sort, long wide channels opening on the sea at one end and into the privy buildings at the other, pouring streams of sewer gas into the air so that there is nuisance all around. Other barracks, including Ireland Island casemates, have cess-pits or shafts causing a similar pollution of the air.

This evil admits of comparatively easy remedy.

The water supply is very deficient; it is collected in tanks from roofs and from the glacis. One of the worst privies is ventilated on to one of these gathering surfaces.

There appears to be no reason why good well-water should not be obtained in any requisite amount both for the troops and for the civil population. The naval wells are said to be inexhaustible. With such a configuration of country, water could be laid on everywhere by gravitation.

The barracks are deficient in means of cleanliness. Better and more ablution accommodation is required.

The hospital is too small for the force and should be extended on better principles, and the present buildings should be improved.

It will be obvious that, if these islands are to be kept free from fever, their sanitary condition should be improved as well as that of the barracks.

The effectual remedy, as far as the barracks are concerned, is to build new barracks on a healthy site, and on the principles laid down in the suggestions which the Barrack and Hospital Committee prepared for the Secretary of State for India, and to supply the new barracks with pure water and provide proper drainage.

This would no doubt require a large amount of labour, and it is worth consideration whether it might not be desirable to send convicts to Bermuda in order to supply the requisite labour.

YELLOW FEVER OF 1864.

Up to the first appearance of the epidemic, the year 1864 was an ordinary one as regards the general health of the civil population. At St. George's there was no warning of the approach of the pestilence, but an uneasy feeling existed on account of the overcrowded state of the town, which had received a large number of sailors and others

engaged in running the blockade on the American coast, ~~&c. In~~ several essential particulars the sanitary condition of the town of St. George was much worse than during the epidemic of 1853. The same want of drains and sewers existed, but with it there was far more overcrowding of confined and ill-ventilated tenements with a filthy condition of the streets, lanes, alleys, &c., and the wharves being loaded with piles of cotton, coals, and other goods, unwholesome in themselves, tended materially to check the circulation of air throughout the houses and narrow thoroughfares.

The climate conditions during the year 1864 were those of ordinary years nor was there any particular lowness of the tides as noticed previous to the epidemic of 1856.

Refuse from the large number of vessels which crowded the harbour of St. George, and offal and blood from two slaughter-houses were frequently observed floating about in a state of putrefaction in the narrow channel between Ordnance Island and St. George's. Entrails of fish were constantly thrown into the same channel, where they underwent a process of slow decomposition.

The harbour of Hamilton also suffered from these causes, but to a far less extent.

The health of the crews suffered from the faulty construction of the vessels, which were built specially for speed (to be used for blockade running) and with but little height between decks. Circulation of air was prevented by all available space being filled with coals or cargo. The crews in general were dirty and dissipated, without discipline, and at night crowded into a very small space.

On shore the houses at St. George's, as before stated, were greatly overcrowded. On all sides, numbers of dissipated, lawless, and dirty sailors, firemen, &c. were seen, who were generally more or less drunk, and always in a state of perpetual debauch. The streets consisted of narrow and tortuous lanes, in which most abominable odours were rife, with no pavements and an utter absence of drains and sewers. Cess-pits abounded which were emptied at rare intervals.

Water supply is generally insufficient and always fails in unusually dry seasons. Rain water is almost universally used for drinking and cooking purposes. It is collected from the roofs of houses and in the country sometimes from the rocky slope of a hill, smoothed and cemented.

The water is conducted into underground tanks, which commonly are cavities cut out of the solid rock and well cemented. On the whole, the water is pure, but in the towns the tanks are often placed near the privies. Nor is it unusual to see cisterns placed immediately under the dwelling houses.

The shipping derived its drinking water from tanks. Its quality is believed to have been pure, but the supply scanty.

Wells are sunk in different parts of the islands. The water in some is scarcely brackish, and in dry seasons is largely made use of.

To the north and west of the town of Hamilton there are tolerably large salt-water marshes effected by the state of the tides. Fevers are not noticed to prevail in their vicinity more frequently than elsewhere, and intermittent fevers are all but unknown. No evidence to prove that these marshes have an injurious effect on the health of persons living near them or of the population generally, although it may be suspected to be the case during an epidemic season. The same may be stated as regards the creeks; when the tide recedes, a quantity of mud is often exposed and offensive emanations are occasionally thrown off, yet the people living in the immediate vicinity enjoy as good health as those residing at a distance, even on high ground.

No burials are now allowed in the towns.

The two first cases occurred in coloured men, on the 19th and 21st June, at a place called "Devil's Hole," south of Harrington Sound, and about six miles south-west of St. George's. Both men had been at work previously at St. George's coaling ships at West's Wharf. All the wharves of St. George's were in the same overcrowded state from lumber and merchandise; they were rarely or never swept or cleansed. Filth of all kinds were allowed to accumulate. All the early cases were met with in the locality where these men were employed, or rather extending from these wharves to higher land situated directly at the north.

The steam-ship "Fannie" arrived at St. George's on the 13th June from Nassau, where a few fatal cases had already occurred. A man who was paralytic, and one suffering from intermittent fever, were the only two sick persons ascertained to have been on board. The latter of these had, at least, three attack of tertian ague, nor were any of the passengers who disembarked attacked with yellow fever. The ship left on the 15th June (having coaled at Fisher's Wharf, on which the man, the third attacked, had been employed) for Scotland, where she arrived without any case of sickness having occurred.

There is no registration of deaths, and no complete registration of burials in Bermuda at present.

The first case among the troops occurred in a sergeant of the 29th Regiment, living under canvass at the rear of the Royal Barracks. He was seized on the 16th July, and died on the 22nd.

The first case in the left wing of the 22nd Regiment, at Boaz Island, appeared on the same day that the first case was noticed in the right wing of the battalion stationed at St. George's, viz., on the 23rd July, although there had been no communication between the two wings.

The man first attacked at the west end had been on guard in the dockyard the day before.

Fever appeared among the dockyard people on the 15th August, on board the "Tenedos" hulk.

The men of the Royal Artillery stationed at Ireland Island were not affected until the 25th August, a full month later than the men of the 2nd Regiment.

About the 24th August fever became intense at Ireland Island, about three weeks, later than at St. George's, and during the whole of September showed great malignity, and by the 13th September the epidemic had reached its height in the town of Hamilton.

The disease thus appears to have commenced at St. George's, on the *25th June* (or 19th?) and at least a month passed before it gained any force. It then travelled quickly over the islands, proving most malignant in the town and dockyard where there were the most crowded and susceptible populations. The last case in Ireland Island occurred on the 23rd November, in the town of Hamilton on the 23rd December, and in St. George's, on the 5th January 1865. The last soldier was attacked on the 10th December.

No ship is shown to have arrived with a case of yellow fever on board until some time after the disease had appeared at St. George's.

The following summary shows the population of Bermuda, and the number of attacks and deaths from yellow fever in 1864:—

Civil Population in 1864	11,450
,, attacked with yellow fever	3,148
,, died from ,,	237
Troops at all stations	1,460
,, attacked with yellow fever	640
,, died from ,,	206
Sailors, R. Navy, strength	98
,, ,, attacked	46
,, ,, died	15
Marines, R. Navy, strength	98
,, ,, attacked	12
,, ,, died	3
Dockyard artizans and labourers, strength	430
,, ,, attacked	162
,, ,, died	10
Grand total, strength	13,536
,, attacks	4,008
,, deaths	471

The mortality amongst troops was much less than in 1853, but in 1864 they were quickly moved out of barracks and encamped, and a large number sent to Halifax in September. About 100 more deaths occurred among the civil population in 1864 than in 1853.

At Ireland Island the mortality was far greater than in 1853.

The epidemic of 1864 is, therefore, shown to have been as severe as that of 1853.

The defective sanitary condition of the town of St. George's, previous to the outbreak, is supposed to have had an injurious effect on the health of the troops in the vicinity; and while unacclimatized persons living in the neighbourhood were universally attacked, although they never entered the town, those who were removed in time escaped attacks to a very great extent.

The only corps occupying barracks and whose health could have been affected by sanitary defects in the buildings were the Royal Artillery and Royal Engineers, and they were quartered as follows:—

Station.	Corps.	Barracks.	Cubic feet per man.
St. George's	Royal Artillery	Fort Victoria	600
		Fort Catherine	1,474
		Fort George	708
		Fort Cunningham	517
	Royal Engineers	Old Sapper Barracks	748
		Fort Albert	752
Ireland Island	Do.	Casemate Barracks	598
	Royal Artillery	Do.	598

The average cubic space per man here shewn is greater than the ordinary average, because in the summer months a portion of the troops is always encamped. In winter the space does not average more than 512 cubic feet per man.

The ventilation in the casemated forts is very imperfect, especially in the lower rooms. The foul atmosphere passes up the staircases from the lower rooms to the upper.

The general condition of the drainage, latrines, and urinals at the military stations may be broadly stated to have been very indifferent, both from the position of those works and from their faulty construction; but no greater nuisance than usual was observed from these sources.

The water supply at each barrack would be sufficient under ordinary circumstances for drinking and cooking purposes, but not for baths and washing linen. Rain water is collected from roofs, and from the smooth slopes of rocky hills, and stored in underground tanks, as before described. The water is generally of very good quality; the average consumption per individual is found to be about five gallons per day.

There is no evidence that intemperance prevailed to a greater extent than usual among the troops.

It is considered advisable that special instructions should be sent out in reference to guards being furnished by the troops in the dockyard during similar epidemics, and also in reference to their being employed on fatigue duties. Up to the time colored labourers were obtained 38 per cent. of the soldiers employed upon this latter duty had died.

The hospital accommodation at St. George's was not nearly sufficient when the sick began to be numerous. The military hospital is constructed for 48 patients, but at 1,500 cubic feet per man; it is not capable of accommodating more than 24. On the 2nd September there were 78 or 79 patients crowded into the wards and verandahs.

On the outbreak of the epidemic the troops were all (with the exception of a few Royal Artillery and Royal Engineers) encamped. Bell tents of double canvass were issued; they had ventilating apertures near the top of the pole. Three men lived in one tent, and had 171 cubic feet of space each; each man had an iron bedstead and a horse hair pillow and mattress.

Several marquees were also pitched near the military hospital, at St. George's, and convalescents from fever, &c. treated in them; by this means the overcrowded hospital was by degrees relieved.

The whole of the sick at the camp at Ferry Point were treated in marquees, and the acute fever cases appeared to progress very favourably.

The effect of encamping the troops was very good.

It appears that every man who died at Ferry Point camp contracted the fever while on duty at St. George's. Not one man died who did not leave the camp, and the only officer who died there had frequently been in St. George's.

The civil authorities of St. George's showed much energy shortly after the outbreak of the epedimic; the first family was encamped and placed in strict quarantine. All houses where fever had appeared were well fumigated and whitewashed. Old hulks were removed from the vicinity of the town. Ships were ordered to anchor out in the stream, and those containing fever cases put in quarantine, and the captains were requested to enforce cleanliness on board. Slaughter-houses were removed from the town; nor were the colonial authorities less alive to the emergency. Three fever hospitals were opened by them. A new Public Health Act came into operation on the 25th August 1864, giving powers to Boards of Health respecting cemeteries, slaughter-houses, manufactories, lodging-houses, infected vessels, the removal of nuisances, and the cleaning of houses, &c. An inspector of nuisances has been appointed in the town of St. George, and others should also be appointed for the town of Hamilton and the country districts.

The Commission urge most strongly the immediate construction of a proper system of sewers in the towns of St. George and Hamilton. Sea-water might be used for flushing. The sewage should be conducted to some distance from the towns and allowed to escape in such a position as would ensure its being rapidly carried out to sea.

The streets of St. George are being widened, and it is important that several open spaces should be left between the houses to allow the south wind to enter the town, as the two main streets run somewhat parallel from east to west.

The ground floors of all new dwellings should be raised some feet above the level of the streets or roads. Ceilings should be a good height, windows of large size, reaching nearly to the ceiling; sinks should be trapped, and no openings leading into drains should be permitted inside dwelling-houses. Walls and hedges round houses should not be permitted, but a light railing might be substituted.

Proper rain water tanks should be provided to all new houses, care being taken not to place them near sewers or privies.

Rain water might be collected from the public buildings and stored for the use of the poorer classes. All tanks should be cleaned out once a year and the "catches" kept clean and whitewashed. A constant inspection of cellars, outbuildings, tanks, dust heaps, privies, drains and sewers should be made throughout the year.

It is proposed that the Government should purchase the Devonshire and Pembroke marshes, and such portions of them as can be reclaimed might be drained and cultivated, or afterwards resold at a profit.

A stagnant pond exists at the base of Fort Cunningham. A cut was made from it to the sea; this is now choked, but could be re-opened at a small expense, and the sea freely admitted. During the epidemic of 1853 the first case of yellow fever appeared in this locality.

Near the town of Hamilton some land might be reclaimed at the end of Crow Lane Harbour, if a sea wall were constructed across the inlet. This would prevent offensive exhalations from the mud at low tide.

Every year before the hot weather the heads of creeks should be cleared of seaweed. All rank vegetation should also be got rid of.

If the Bermudians were to devote serious attention and some money to the enforcement of hygienic measures, these epidemic outbreaks may probably be altogether warded off or greatly mitigated.

The strength of the white troops should be reduced to a minimum and a proportion of colored troops introduced.

There is not nearly sufficient barrack accommodation. The situation on which wooden barracks are about to be constructed on Prospect Hill is good; wooden huts should be more lofty than in England and the windows larger; ridge ventilation should be carried through the entire length of the roof. Fireplaces and chimneys are very useful. Every man should have at least 750 c. ft. and 50 sq. ft. of space. The huts should be raised from the ground on stone footings and should be surrounded by a broad, lofty, and nearly horizontal verandah. They should extend in a line from east to west.

If colored troops are introduced they should be concentrated at St. George's to avoid keeping many white soldiers in the vicinity of that town.

The royal barracks are too closely surrounded with outbuildings, several of which are too small and should be pulled down and more suitable buildings erected in more open localities. Three cottages near the officers' privy have proved so unhealthy during the late epidemic that they had better be pulled down.

A new regimental recreation room is greatly required; the present one is too small.

The regimental cells should be rebuilt on a better site.

In wet weather the strong room under the guard-room is flooded by rain.

The guard-room requires ridge ventilation.

Additional married quarters are required at all the barracks.

The Royal barracks are scarcely raised above the ground level and are found hot in summer. The ventilation is defective. Free ridge ventilation is required. The windows are too small, they should be carried up to the roof. More under-floor ventilation is required. These barracks would be much improved if the roof could be raised four feet.

The line officers' quarters were very unhealthy both in 1853 and 1864; they should be pulled down and rebuilt on a more modern plan. They can, to a certain extent, be improved by throwing a front and back room into one quarter, and folding doors might be introduced, reaching to within 3 feet of the ceilings. The ceilings and windows could be heightened more than a foot. Larger air outlets are necessary. More officers' quarters are required. The boundary wall in front should be replaced by an iron railing. The ground opposite and to the south-west should be lowered at least 2 feet, and the portions of the trees overhanging the roof should be lopped away.

The military hospital requires to be enlarged.

The system of keeping purveyors' or other stores under the hospital is highly objectionable.

A more thorough circulation of air through the basement is advisable.

The Military Prison is in a close confined situation. If a large number of apertures were made through the walls six feet from the ground, ventilation would be a little improved, but discipline might possibly be impaired.

The town main-guard is in a hot unwholesome situation, and is badly ventilated. The guard-room on Ordnance Island should be enlarged. (Both guard-rooms can scarcely be required.)

A wooden hut might be built midway between Forts Victoria and Albert for a canteen

and recreation room. At present, the Royal Artillery recreation room is a dark gloomy room in the casemates of Fort Victoria, and the canteen in Fort Albert is a small and uncomfortable room.

The redoubts around St. George's should not, if possible, be occupied by troops during peace. There is no proper circulation of air through the rooms, which from their construction, can scarcely be remedied. Under no circumstances should the lower rooms be used, except in time of war.

Wooden huts for a small number of men might be erected outside the redoubts.

The main guard-room in the dockyard at Ireland Island should be pulled down and rebuilt on higher ground.

The married quarters at Ireland Island require additional ventilation.

Additional tanks should be provided at Ferry Point and Fort Cunningham, as well as at the Military Hospital. A large one at Gibbs' Hill would prove useful in the event of a camp being formed in that elevated locality. Tanks should be removed from under barracks. Coarse wire strainers should be placed at the entrance of the pipes to prevent leaves of trees getting into tanks.

Rain water might be caught from the parapets of the redoubts, and used only for washing purposes.

Baths are not provided at any of the barracks. One bath for every 100 men should be furnished.

The new drainage scheme, already sanctioned for the station of St. George's (the barracks ?), should be carried into operation as quickly as possible. When completed all cess-pits will be abolished and the sewers flushed with salt water. Either Jennings' or McFarlane's privies should be generally introduced.

Games of the greatest possible variety should be provided, and books of a lighter and more attractive character than those in the garrison library, should be provided for the use of the troops.

In the event of a future epidemic troops should be quickly encamped at Ferry Point. A few wooden buildings, such as a small temporary hospital, commissariat, and purveyor's store-rooms and offices, and bakery, &c., would be required in the neighbourhood of the camp; these might be erected on the higher ground to the north of the peninsula.

A man-of-war or troop-ship should, if possible, remain off Ireland Island during the months in each year when an epidemic outbreak may be expected.

Troops should arrive at Bermuda during the month of November.

A code of regulations defining the exact mode of procedure during epidemic seasons should be drawn up by the authorities in England.

In transmitting the report of 1864, the Lieutenant-Governor states in regard to the epidemic and the possibilities of effecting sanitary improvements, &c.:—

"After it had once began, there is every reason to believe that it was fostered and "propagated through the absence of sanitary precaution. In many communities such "an admission would amount to a reproach. I am concerned, therefore, that the com- "missioners did not, in justice to Bermuda, set forth the disabilities under which the "colony labours; as, for example, that no civil engineer or even master builder is to be "found here; that the whole population is under 12,000 souls; that this population is "poor; and that labour and the appliances of art are exorbitantly dear."

And further, as to the employment of coloured troops, he says:—

"The Commissioners advocate the employment of black troops in Bermuda. I think "that a small number, say 50 men, would always be useful, and that in time of sickness "they would be especially so, as hospital orderlies, boatmen, carters, and grave- "diggers."

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