

**Report on the malarial epidemic fever of Mauritius of 1866-67, (with plans of Port Louis and Flat Island, and a map of Mauritius, shaded to show the distribution of the fever districts) / by John Small and W.H.T. Power.**

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R E P O R T

ON THE

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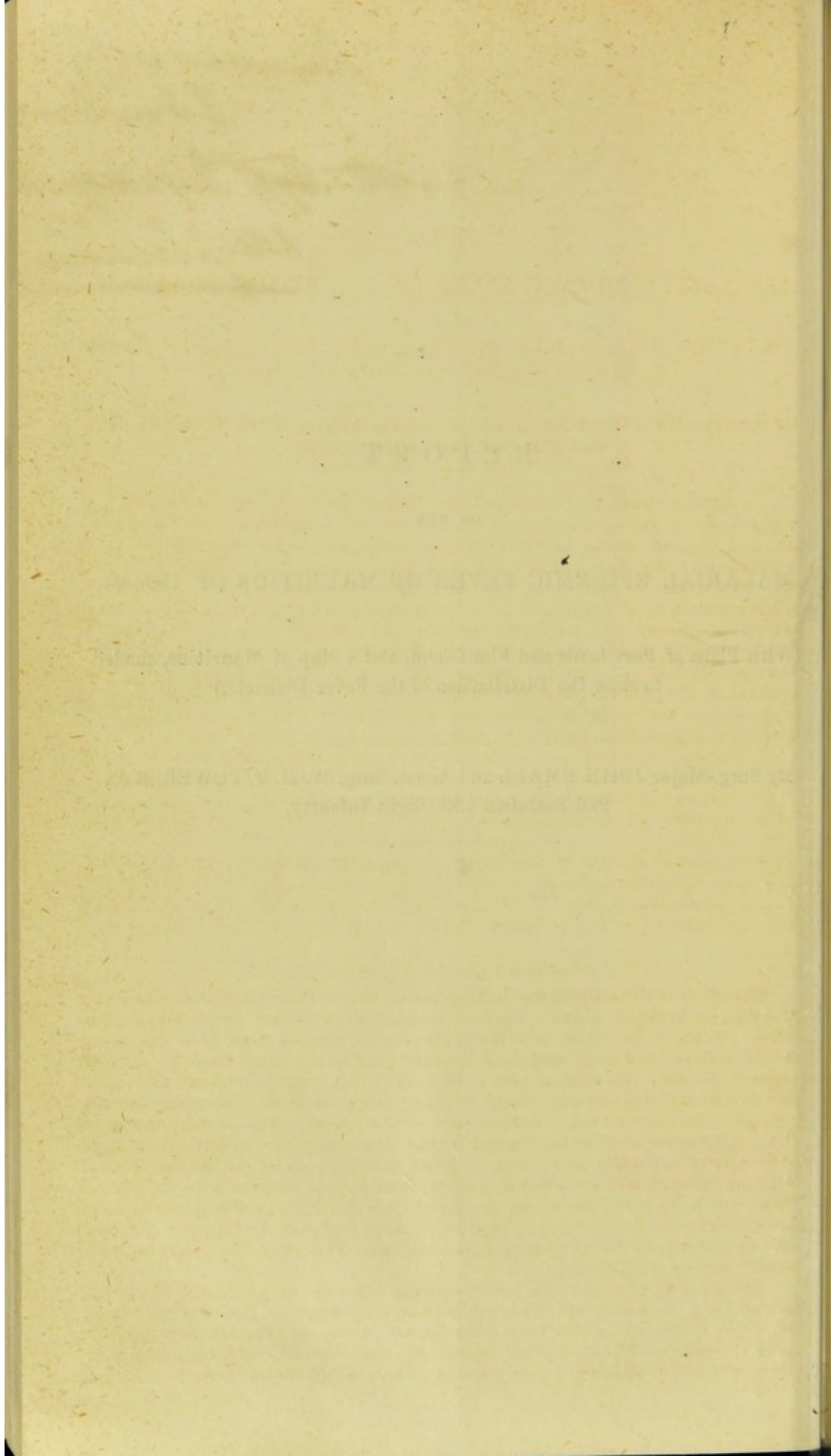
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By Surg.-Major JOHN SMALL and Assist.-Surg. W. H. T. POWER, B.A.,  
2nd Battalion 13th Light Infantry.

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# REPORT

ON THE

## MALARIAL EPIDEMIC FEVER OF MAURITIUS OF 1866-67.

(With Plans of Port Louis and Flat Island, and a Map of Mauritius, shaded to show the Distribution of the Fever Districts.)

By Surgeon-Major JOHN SMALL and Assistant-Surgeon W. H. T. POWER, B.A.,  
2nd Battalion 13th Light Infantry.

THE small island of Mauritius, the sufferer from the severe epidemic of malarial fever during the hot season of 1866-67, is apparently so favourably situated that one would hardly expect to meet with the sudden appearance in an epidemic form of a genuine malarial fever, which had hitherto occurred only to a small extent in it, and had, up to the end of 1866, been almost entirely confined to emigrants from India, a race who had emigrated from a malarious country, and who, consequently, had a constitution previously modified by malaria, and especially, though not exclusively, those arriving from the Bombay Presidency: hence it will be necessary to give a somewhat detailed account of the general physical features of the island, in order to endeavour to show how the malarial poison was produced. For this purpose we have deemed it necessary to divide the subject under the following heads:—

- I. Physical features and meteorology of Mauritius, with details of the various districts, especially those in which military stations existed.
- II. Comparison between the fever and non-fever districts.
- III. A history of the battalion in relation to the fever to the end of the year 1867.
- IV. A general account of the fever, its symptoms, pathology, and treatment.
- V. (As Appendix.) On a peculiar form of dysentery, which attacked the battalion in April 1867, when at Flat Island; also a few remarks on "enteric fever," prevalent during the epidemic in Port Louis.

### I. PHYSICAL FEATURES, METEOROLOGY, &c.

Mauritius is situated in the Indian Ocean, its greatest length 40 miles, and 30 miles its greatest width; its area is 432,680 acres, or about 680 square miles. Volcanic in origin, it is made up of lofty rugged mountains with deep fertile valleys, and long slopes of varying incline running from the centre towards the sea. Its central part a high table-land, while a small portion of flat, and in many places sandy, soil, is found along its shore, extending into its greatest area towards the northern part of the island. The general nature of the soil, however, is alluvial, formed by the detritus of the volcanic rocks. It is usually of no great depth, but of great fertility; once clothed by forests, with an undergrowth so dense as to be almost impassable, the only remains of them now to be found are about the summits of the hills in the upper lands of the districts, the forests having been levelled for the purposes of sugar planting and as fuel supply for its enormous population. The island is nearly entirely surrounded by a coral reef.

*Geology.*—It presents the same general features as most other volcanic islands—viz., a central and elevated plateau, representing the original crater, which, by its eruptions, has formed the island, surrounded in part by a range of hills, (the remains of the original crater wall,) with various ridges running from them, and slopes of basalt (once streams of lava which flowed from the original



and minor craters at varying slopes to the sea). This original crater and its wall have been more or less altered by varying elevations and depressions, accompanying subsequent volcanic eruptions caused by movements from time to time of the same seismic force, which originally elevated the crater from the sea. A volcano still active exists in the neighbouring island of Reunion, 120 miles distant from Mauritius. The great mass of the island is formed of basalt, tuffaceous rock and lava, and the soil formed by their wear and tear in many parts is a stiff dark clay, but principally the soil is light and porous, more or less red in colour from the presence of iron. All over the soil are scattered in vast profusion loose blocks of basalt of all dimensions. Along a portion of the coast the remains of an old coral reef (now dry land) exists, and close to the sea there are portions of land made up of coral and marine shells, and in a few places a soil of friable limestone, containing land shells, is met with. Several of the small islands off the coast are composed of a portion of old coral reef as a nucleus, round, and on which, coral débris, &c., have collected.

*Vegetation.*—The whole of the arable portion of the island is nearly exclusively devoted to the culture of the sugar-cane, of the forests with which formerly the island was clothed, now but little remains, and even this small portion is gradually disappearing to make way for the sugar plant. In many parts along the seaboard, where the sandy nature of the soil precludes any other cultivation, belts of the "filao," a species of fir from Madagascar, have been planted with much success, but not to an extent sufficient apparently to exert any marked influence on temperature or rainfall. In the cool upper lands, and in many parts of the coast where irrigation is obtainable, all kinds of vegetables are cultivated with success, as are likewise fruit trees everywhere, and fields of maize, rice, &c., are also not infrequent.

*Rivers.*—There are many rivers which always flow, but the amount of running water in them is steadily decreasing, owing to the continued destruction of the forests in the high lands, and denuding the smaller hills of their wood. To intertropical countries like Mauritius forests are indispensable, as by their absence the country is exposed either to droughts or to inundation. As the trees placed by nature to prevent, or at all events to modify, such evils are now being indiscriminately destroyed, and none planted to replace them, the rain water, therefore, instead of being sheltered and contained in the soil at once runs off, carrying with it much vegetable and other matter, which is deposited along the banks of the rivers and other watercourses, and on the low-lying lands. The land in many parts from its clayey and impervious nature retains much water on its surface, the greater portion of which disappears by evaporation. Contrasting greatly with countries like England, where such immense natural reservoirs of water are found underground, from the rain water percolating through some porous rock till it meets with a comparative impervious one. At the same time there are wells in Mauritius, many sunk in sandy soil. In them the water is hard, being impregnated with lime salts. In several places a sort of subterranean river has been reached, and there the water found is pure and excellent. There are also extensive collections of water which have passed into some of the numerous long caverns, which are usually found in volcanic countries. It must be said, however, that even should the destruction of the forests continue, the quantity of rainfall must not necessarily decrease, as it is yet to be proved that trees influence to any great extent the fall of rain. Doubtless, forests have some influence upon the electrical condition of the atmosphere, but it would be difficult to determine the amount, and a small island as Mauritius, far from any continent or large mass of land, and surrounded by the sea, must, under the sun's influence draw a continual and large amount of humidity from the ocean; and as all the winds must thus be highly charged with it, much rain will be deposited in passing the higher and colder parts of the island. The rivers on the windward side are purer than those of the leeward; they are also more numerous and of larger volume. The impure condition of the leeward rivers is, in all probability, caused by their passing through, and draining districts more highly cultivated and populous. Before the cultivation of the sugar-cane was so general and all-absorbing, and the rural population less dense than it now is, the rivers, besides being larger in volume, were likewise less impure, as all the filth and



surplus drainage of the then small population was readily carried off without giving great impurity to the water; but at the present time from the great increase of sugar establishments, distilleries, &c., and the consequent enormous increase of men, mules, and cattle necessary to work them, the amount of impurity continually deposited in and around large estates and Indian villages, is very great, and nearly all this is carried off by every shower, and finds its way into the rivers and other watercourses, to say nothing of the direct pollution of rivers by the washing of clothes, persons, and animals.

*Lakes and Marshes.*—There are several collections of fresh water, forming small lakes, to be met with in the upper lands; but these generally are of no great importance as supplies of water for human use, with the exception of the "Mare Aux Vacoas," in the Vacoa district, which drains the surrounding hills, and from which the Tamarin and other rivers take their rise. Marshes are more numerous, and for the most part are found at or near to the mouths of rivers. A good deal of marshy ground is to be met with in the high forest lands, but it is usually covered by water. Those on the coast vary from one or two to 60 acres in extent, and contain in many brack water, though in some the water being supplied by numerous springs, is fresh. Of these there appear to be two varieties, one and the largest kind being of peat, with water underneath, is never dried up, as in the large marsh at the military post of Flacq; the other usually smaller in extent, being a mere mixture of mud and water as is found all along the coast between Port Louis and Black River. These, in the hot and dry seasons readily dry up; they are more or less covered with patches of rushes, and the mud is composed chiefly of vegetable matter in various stages of decomposition. At the river mouths, where the fresh and salt waters meet, "barrachois" exist, usually an extensive bank of fetid mud, which at low tide in all seasons, but especially so in dry ones, is left for many hours exposed to the sun's rays.

*Climate and Meteorology.*—From its position, near the centre of the Indian Ocean, and between the tropics, and far away from any large masses of land, the climate of Mauritius is, as might be expected, equable, and not liable to any marked and sudden changes, at the same time, owing to its very mountainous character, considerable local differences of temperature and rainfall exist; hence it seems scarcely possible, except by direct conveyance through human intercourse, that diseases should have any other origin, except one derived from and developing in conditions natural to the island itself, or in conditions resulting from ignorance or neglect of these laws of health which must be observed in all crowded communities. There are but two seasons in Mauritius, the hot and rainy one, from middle of October to middle of April: and the cool and dry one, from middle of April to middle of October. The temperature varies much: as the high lands of Moka, Plaines Wilhems, and Flacq are reached, the thermometer marking from 6° to 10°, according to height, lower than in Port Louis. During a period of 13 years, up to the end of 1865, the mean annual temperature at Port Louis was 83° during the hot season, and 74° during the cool. The rainfall in amount varies much from year to year; more rain falls on the windward and on the central parts than in the rest, January, February, and March are the rainiest months, but occasional showers fall all through the year. The winds, which blow from the south-east (trades) during the greater part of the year, give the atmosphere a cool and agreeable freshness; it blows pretty strongly, and is almost always dry. The wind from the north-east is generally prevalent during the three first months of the year, and is accompanied by heavy rains. The north wind is always a rainy one, as are also, though in a less degree, those from N.W.W. and S.W.; these winds are oppressively hot, and considered unhealthy. From December to April the island is liable to hurricanes; these cyclones are always preceded by great heat, and a sombre calm and heavy atmosphere; these storms usually begin by a wind from the S.E. or E., and so soon as the wind turns to the north the violence of the storm gradually diminishes. Hurricanes of late years have neither been frequent nor severe, though the one occurring in 1861 (and the last) continued for six days, and did much damage. The island is singularly free from great thunderstorms; however, during the months of the hot season, and especially from November to January, thunder and lightning are not infrequent. Slight shocks of earthquakes have been occasionally experienced.



*Population.*—The census of 1861 gave a total of the resident population amounting to 310,050 ; at the end of 1865 it had increased, by Indian immigration principally, to 340,835, exclusive of military (of this number the Indian population amounted to 245,852), and in the first six months of last year, 1866, as many as 3,577 (Indian immigrants) were added, since which we are not aware of any additions from that source ; thus, before the epidemic broke out, the population may be computed at 344,412 souls ; of this number, 95,205 are classed under the head of "general population" (the remainder being Indian), comprising Europeans properly so-called, and those born in the island of original European stock, Mulattoes, Chinese, Arabs, Persians and Africans from Madagascar, the Mosambique Coast, and Abyssinia.

*Meteorological Phenomena of the Hot Seasons, 1866-67.*—In the absence of the observations of the Meteorological Society, at present we can only speak generally on this subject ; during this season the following were its marked characteristics :—

1. Absence of usual amount of rainfall.
2. A higher temperature, and continued much longer than usual.
3. Absence of usual amount of thunder and lightning.
4. No hurricanes occurred.

In summing up this, we may say, that the marked characteristic of the season was a dry stagnant state of the atmosphere, with high and long-continued temperature.

*Changes which have occurred in the General Physical Features and  
Population of the Island.*

1. A very large amount of forest land has of late years been cleared for purposes of supplying fuel and for cane cultivation.
2. Immense increase in number of inhabitants, not in the usual manner, by excess of births over deaths, but by increased immigration from India.
3. This increase of population has been followed, by the close aggregation into villages, of an immense number of Indians, who, their term of engagement being completed, have settled in Mauritius in various employments, and who, being under no surveillance whatever, have, from their well-known filthy habits and mode of life, become a dangerous nuisance.
4. The amount of rainfall for past year much diminished ; also, and for several years past, serious decrease in the amount of water in the rivers.

DISTRICTS.

*Port Louis* (see sketch plan).—Area, 10 square miles ; population (before epidemic), 80,000, or 8,000 to the square mile. This by far the most densely-peopled district in the island, includes, (besides the town which gives its name to the Canton,) Grand River, N.W., Rochebois, and Vallée des Prêtres, it is situate on the westward or leeward side of the island, and forms a rough segment of a circle, the circular boundary being formed by a range of hills, and the straight one by the sea ; its surface is nearly flat, and apart from the mountains but a few feet above the sea level ; several valleys exist, formed by the spurs of its hilly wall ; these hills lie to windward and form, as above described, rather more than a semi-circle, consequently in the hot season the movement of air is but slight, and the heat very oppressive. The soil of the greater portion of the district, and especially that on which the town is built, consists of the detritus of the rock of the adjoining hills, it is very tenaceous, resembling clay in appearance, varies in depth, which is greatest as it nears the sea ; mixed with it are boulders of undecomposed basalt, rounded as if weather-worn at some former period. In the lower parts of the town, and near to the water-edge, many houses are built on what was once a portion of the harbour, filled up by the deposit of silt from the hills and town during the rainy seasons. The harbour through a large opening in the coral reef, runs deeply into the land ; the rise



and fall of the tide is insignificant, and the whole of the surface drainage of the town is conveyed into it by several foul rivulets, which, having no volume of water, nor sufficient fall as a sewer, deposit part of the filth with which they are charged in the beds and along the sides of these streams, but by far the larger portion ultimately reaches the harbour, where it remains, and at low water is exposed to the sun. There are two forts, which command the entrance of the harbour, viz., Forts William and George. The ground lying between Fort William and the town is quite flat, and parts of it to windward a tidal marsh. The cemetery is also to windward and to the S.W., and close to it is much marshy ground and salt-pans. From the fort, which was garrisoned during the epidemic by Royal Artillery, scarce one escaped the fever. Fort George, where large barracks are being constructed, has to windward a large nearly stagnant part of the sea (*Mer Rouge*), of many acres in extent, which formerly had sufficient depth of water to admit coasters, but which now is gradually being filled from the rising of the coral reef, but principally from the continual deposit of vegetable and other matters conveyed to it by several of the sluggish filthy streams which traverse the town. The stench from this mass of putrifying matter was at times most disagreeable. The Caudan, another nest of malaria, where many of the married families of the Royal Artillery and Royal Engineers were housed, and where are the workshops of the latter, is situate on a low-lying portion of land, the greater part of which was reclaimed from the harbour by the deposit from two small streams, which, after draining that portion of the town above the Caudan, enter the harbour at this point well charged with filth of all descriptions, and which always gives off an abominable stench. The Caudan is but a short distance from Fort William. Within a few hundred yards of the Caudan, and to windward of it, is located the Artillery Barracks, which, from its close proximity to this low-lying marshy land, and to a foul tidal stream, which holds its sluggish course all along the seaward aspect of the buildings, can never be in a good sanitary condition. A short distance from these barracks, and still to windward, are situated the Line Barracks; they occupy a large space of ground of about 22 acres, but are surrounded by a poor and densely-populated neighbourhood. The soil on which they are built is, as before stated, tenaceous clay; at this part from 2 to 6 feet in depth, and lies directly on the hard basaltic rock itself. The drainage is imperfect, there not being sufficient fall, and from the nature of the soil, there is scarcely any percolation for the surface water, which usually disappears by evaporation. The buildings themselves have been so often described, repetition here is not thought advisable; suffice it to say, that the barracks are fairly good and well ventilated, and, from the considerable extent of space which they enclose, freer movement of air is permitted than in most other parts of the town; still, from the noted insalubrity of their site, it would be without doubt far better to construct others in the cooler and more elevated inland parts of the island, as midway between Port Louis and Mahebourg; and now that a railway connects these towns, there would be no difficulty in conveying troops in case of need to either. Port Louis has always been a dirty, overcrowded, undrained town, and, consequently, very unhealthy, and now that malarial fever has shown itself to be an additional evil, there can be no doubt that, on sanitary grounds, troops should no longer, at least in any number, be kept there, and in so small an island it is only a question of a few miles (7 to 10) to place the barracks in a healthy, mild, and equable climate, from a close, hot, and pre-eminently unhealthy one. If steps are at once taken to drain, and otherwise purify the town before removing the troops, in all probability there will be much sickness among them, and especially from "typhoid fever," from disturbing soil which is saturated with the decaying filth of many years. The same objections apply to the hospital; the buildings themselves are well ventilated, fairly cool—cooler than barracks, but the site is a most objectionable one, being close to the commercial centre for traffic, in its busiest and noisiest part, nearly a mile from the barracks, has the railway within a few feet of its outer wall, and the filthiest portion of the harbour, the "Trou Fanfaron," but a few yards off. Among the other *desiderata*, it has no wards for noisy patients, nor for those suffering from dysentery. Fort Adelaide, constructed some years ago to command the town and inner anchorage, is a stone fort, built on the extremity of a small spur running down from the



mountain chain, and terminating at the upper part of the town: it is usually garrisoned by two companies; the rooms are casemated, not well ventilated, very close, and hot. Further on, will be found the history of its garrison during the fever epidemic; the water supply for the barracks is plentiful and very good; is taken from the Grand River, N.W., at some distance from its mouth, and conveyed to Port Louis by iron pipes.

*Pamplemouses*.—Area, 87 square miles; population 59,000, or 678 to the square mile; a large part of this district (which lies to the north of Port Louis) is flat, and from this an upper portion runs up among the inland hills, while the rest consists of low ridges of basalt with intervening valleys, the whole bristling with detached basaltic rocks; there is but a very gradual slope towards the sea; along the shore is a band of varying breadth, and about 15 miles in length, of coral sand formation, which at Cannonier's Point expands into a tolerably large plain, at the extremity of which is placed the military post, which gives accommodation for 50 men, adjoining to it are lighthouse and an extensive quarantine establishment for small-pox; the whole of this establishment was lent by the civil Government to the military as a convalescent dépôt during the epidemic, for part of the 13th Light Infantry and for the Royal Artillery; from its exposed situation and being almost treeless, there is always ample movement of air in the hot season; the winds are all sea breezes, and in the cool season the trade wind blows over so small a portion of the land before reaching the post, that it also may be termed a pure sea breeze; there is much marshy ground in the district along the coast as well as at the mouths of the rivers, and in many parts of their course these streams, as they approach the sea, pass through very nearly a dead level; attached to many of the estates and private houses, are large ponds, or "*bassins*," which, being stagnant, are for the most part half filled with weeds and decomposing vegetable *debris*. In many parts collections of fresh water lie for a time after the rainy season until (from the impervious nature of rock which forms their bed) they disappear by evaporation; this district, as well as the adjoining one to the east of it, *Riviere du Rempart* (area, 58 square miles, population 21,468, or 370 to the square mile) resemble each other so much in their general features, especially in both having so much stagnant water and marshy land, that it will save repetition to consider them together; these districts, considering their extent, are but scantily supplied with water, the rivers being few and of no volume, much of the water being taken from them at the upper parts of their course for the supply by canals of portions of these districts and Port Louis; also much is expended in irrigation; apparently this part of the country was never well supplied with water, as at the taking of the island in 1810 by the English, the troops, who were disembarked at Grand Bay, in the district of Pamplemouses, suffered greatly on account of the want of it, during their march on Port Louis; the whole ground was then a dense forest, indeed the formation of the ground shows that no other streams but those now known ever existed. *Riviere du Rempart* has a good deal of flat rocky ground resembling a pavement, which is called *Plaine des Roches*; it is undermined by caverns such as are frequently found in lava-formed countries; both these districts suffered severely from fever.

*Flacq*.—Area, 113 square miles; population, 46,000, or 370 to the square mile; this district lies to the south of *Riviere du Rempart*, and is the largest in the island, and one on which the fever epidemic fell lightly, indeed the deaths from fever were scarce, if at all, above the average of past years. It has a coast line principally of coral sand formation, about 19 miles in length, but of no great breadth, interrupted here and there by indentations, usually opposite corresponding openings in the coral reef, forming harbours; the sand dunes are nearly everywhere thickly planted with the *filao* tree, and have in addition a covering of coarse grass; the ground generally in the district is very rocky with a soil, in the low lands, of a light porous loam, much of it of a red colour (as at Pamplemouses), from the presence of iron, and is very fertile; the soil in the upper lands, where in many parts the forest has been cleared, is the usual tenaceous clay, which, by the addition of guano, is rendered equally fertile for cane cultivation, as the rich loam of the lowlands. The ground from the coast rises gradually in one long slope, varying in breadth from four to six miles until it reaches the mountains, where the



rise becomes more rapid; these mountains have, for the most part, their summits and upper slopes clothed in forest. Flacq is fairly well watered, having several rivers traversing it, one of which is the largest, as to volume of water, in the island; in the low lying lands, and near the sea, there is much marshy ground, especially along the course of the rivers at their mouths (Barrachois), where the usual bank of fetid mud is found, which exists at the mouths of nearly all the Mauritian rivers; there are also several collections of brackish water, locally called "mares," along the coast, which are fringed with mangrove bushes and studded pretty generally with rushes; the temperature in the low lying lands is generally from 3° to 4° lower in the hot season than Port Louis, and the upper lands enjoy a cool and agreeable temperature at all seasons; the prevailing wind is the S.E. (trades), which is here a sea breeze, and which blows pretty steadily for eight or nine months of the year. The military station "Post of Flacq" is placed at the head of one of the small harbours and faces nearly due east; the garrison has usually consisted of 100 men; the barracks are built close to the shore, and about 15 feet above the sea level; the ground is flat and well shaded by large trees, the post being nearly on the windward side and far from the hills, there is always free movement of air; within 200 yards of the post and to the south of it there is a large marsh of some acres in extent, communicating with the sea and with the mouth of the "Riviere du Post," which has a thickness of five or six feet of peat, with water underneath, and which is saturated with the refuse of a rum distillery in the neighbourhood; between this marsh and the post there is a dirty undrained village, which, from pigsties, dung-heaps, and other filth, has always been in a dirty condition; there exists also a good deal of damp ground round the post during and for some time after the rainy season, from overflowing of rivers, &c. Distant from Flacq Barracks 11 miles to the south, and still on the coast line, is the small military post of Grand River, S.E.; it is placed on a rocky spur of the neighbouring mountains, but separated from them by a river, Grand River, S.E.; the land runs out seawards, and facing the east is well exposed to the sea breezes; trees have been lately planted, which soon ought to furnish shade which is much wanted; its aspect and elevation ~~X~~ favourable, and there are no Indian villages to windward nor near to it on any side; it has usually accommodated 30 men. *an*

*Grand Port* (area, 112 square miles; population, 41,200, or 368 to square mile) lies to the south of the last-named district, and separated from it by a mountain range, and by the "Grand River, S.E."; the area is nearly the same as Flacq, but the population is considerably less; the coast line is about 30 miles in length, and placed in the centre of it; and facing a magnificent bay is Mahébourg, the chief town of the district, and the military station; the coast from the Flacq or northern boundary to Mahébourg, about 14 miles in length, is broken into many small bays by spurs from an outer mountain chain, which runs down to the sea; between these ridges are well wooded, and in part well cultivated valleys, traversed by several small streams; there is much marshy land in the upper parts of the valleys, as well as along the course of the streams; they are, however, always covered with water. At the mouths of all these rivers there is more than the usual amount of mud exposed at low water; there are no sand-banks on this portion of the coast, the soil in many parts, a rich loam, being cultivated to near the water's edge; the remainder of the coast line on the other, or south-west side of the town, is for the most part coral sand formation, broken in one or two places by indentations, and in one part, no reef existing, the sea breaks directly on the rocky shore; the sand dunes, for miles, are planted with quite a forest of filao trees; this, the larger half of the district, is an extensive plain, rising gradually inland to the mountains; it is less rocky than Flacq, but like it entirely devoted to cane cultivation; there exist but few collections of stagnant water, and but little marshy ground is to be found along the river. During the rainy season, and for some time after, various hollows, locally called "Mares," filled with clear, pure water, some of them miles apart, have subterranean communications with each other, from the water filtering through the cracks in the stony soil. The town and military station of Mahébourg are built on low-lying narrow spit of land a mile in length, and varying in breadth from three-quarters of a mile on the south to a mere point on the north, locally called "Pointe des Anglais."



This peninsula is formed by the Rivière la Chaux, on the west, and on the east and north by the sea. The town, which contains 6,000 inhabitants, is, like all other Mauritian towns and villages, badly built, undrained, and consequently very filthy; the water supply is good and sufficient, the source being the Rivière la Chaux from which it is taken, about two miles from its mouth, and conveyed by a canal of masonry, in parts only covered, to the station, where it is distributed over the barracks by iron pipes. The rainfall is more abundant on this, and indeed all along the windward, than any other part of the island, owing to the prevalent sea-breeze, which is always more or less charged with vapour, blowing with much force against the series of mountain chains forming the inland boundary, where from pressure and parting with its heat against the colder hills, condensation takes place; possibly also from the resistance offered by the forests, though this, as a cause of rainfall must be very slight. In 1865, when the battalion was stationed (head-quarters) here, the rainfall during that year was—

	Inches.
Upper part of the district ... ..	192.45
Lower down.... ..	135.31
On coast .... ..	100.84½
And at Port Louis during the same year....	44.737

The barrack accommodation at Mahèbourg is too limited for the number of troops which have been usually quartered there; still Mahèbourg, as a station, has always been a healthy one, notwithstanding this overcrowding and the apparently unhealthy site; the mouths of two of the largest rivers in the district meet the sea within 500 yards, and to the north of the point of land near which the barracks are situate, where they have deposited an enormous mass of debris, which from its quantity not unfrequently changes the course of the channel, and at low water exposes its many acres for hours to the sun. On the south-west of the barracks along the coast there are many salt-water lagoons, fringed, and in some points covered with mangrove bushes, around whose many roots collect much foetid mud; close to, but to windward of, these lagoons, and on the northern extremity of the sand dunes before alluded to, is placed the camp for rifle instruction, Point d'Esney, and at a part well shaded by filao trees. This district has still a good deal of forest land in its upper section, which, however, is daily lessening.

*Savanne*.—(Area, 92 square miles; population, 233,317, or 253 to square mile.) This district, like its neighbour Grand Port, escaped the epidemic malarial fever (the deaths returned as "fever" during the period being actually fewer in number than in corresponding periods of past years); they also resemble each other in their physical features. Savanne, however, has less marshy ground, and the mouths of its rivers, from their greater rapidity, are freer from deposit. The reef also is much closer to the shore, so that the sea between is always more agitated; along a considerable portion of the coast line are the usual low coral sand dunes, planted with the filao tree; part also is high, bold, and rocky, and free from coral reef; the district is cool and healthy, and faces the south-east, and is well exposed to the trade wind. No troops have been stationed here for 19 years; the forest land is still very considerable.

*Black River* (area, 94 square miles; population, 18,902, or 201 to square mile), is an extremely mountainous district, on the leeward side of the island, having but a small amount of flat ground (except towards the northern boundary) between the mountains and the sea. There are, however, several deep valleys which run up among the hills, and towards the "Morne," or southern extremity, ~~and~~ an inconsiderable portion of plateau exists at an elevation of about 800 feet; all or nearly all of this ground is under cane cultivation, in the culture of which irrigation is extensively employed. There are several rivers in the district, which, in the upper portion of their course, are very rapid, but which become sluggish on reaching and passing through the low-lying alluvial lands on their course to the sea. At the mouths of these streams, there exists large deposits of the usual black foetid mud. The military post of Black River is situated on the coast, within a few feet of the sea, and at the mouth of the Black River; it occupies a portion of flat ground running up inland into a narrow valley. The hills in this half of the district run close down to the shore; some are of



considerable elevation, and are placed to windward. Hence in the hot season the heat is very great, and the movement of air very slight. After heavy rains, a great amount of vegetable debris is brought down by the river, and scattered along the shore, frequently to a thickness of some feet. It is the most confined, and consequently the hottest military station in Mauritius. There is much marshy and damp ground along the rivers in their course through the flat lands, and a good deal of stagnant water and saline swamps are to be met with between the Tamarin River and the boundary of the district to the north. The post has usually been very healthy, in spite of its heat and closeness, but suffered fearfully from the malarial fever of 1867.

*Plaines Wilhems.*—(Area, 70 square miles; population 31,000, or 443 to a square mile). This district is made up of two distinct portions, an upper and a lower. *The upper part* forms a large portion of the central plateau of the island, reaching, as at Curepipe, midway between Port Louis and Mahebourg, to a height of 1,500 feet; about 7 miles below Curepipe in a north-west direction, there is a second extensive plateau on which it is proposed to construct barracks for the troops. The soil in the upper lands is moist and clayey; lower down the usual red earth, or the dark porous loam, and on the coast, here and there, coral sand. There are several rivers which, for the greater part of their course, run between high precipitous banks. The water supply is taken from them in the upper lands and distributed all over the district by open canals; the water in them is generally much polluted. In this half of the canton there is always free movement of air, and the temperature is ordinarily 7 to 10° lower than at Port Louis. *The lower portion* is hot, dry, and stony, and not so extensively cultivated. Near the sea, and along the whole line of coast, there is much swampy land. At the northern extremity of this coast line, and close to the extensive embouchure of Grand River, N.W., is placed the military post of Petite Rivière, where one company is permanently stationed (in wooden huts) all the year round, and where, during the cool season, the rifle practice for the greater part of the troops is carried on—these men being under canvas. The soil is sandy, and the country slopes inland very gradually from the post. The water supply is brought from Grand River by water carts, not usually very good. The Port Louis hills are near enough to make their influence felt by preventing free movement of air.

*Moka.*—(Area 68 square miles; population 19,473, or 283 to a square mile.) This district, like *Plaines Wilhems*, must be divided into an upper and a lower portion. *The upper forms* an extensive well-cultivated plateau, placed behind the hills, which wall in Port Louis and Pamplemousses, and has an elevation of from 800 to 1,200 feet above the sea. The temperature varies from 6° to 9° below Port Louis, and the climate is always cool and agreeable. The rainfall (1865) in the upper parts of the plateau is large, 147 inches in the year, and at its lower border the amount in the same year was 79.44. The water supply is taken from the rivers high up, and, as elsewhere, distributed over the district by open canals. Two small detachments of a line regiment are stationed here forming guards for the Governor and for the General, both of whom reside in the district. *The lower portion* is very narrow, and slopes rapidly down to the low ground in the suburbs of Port Louis. It is shut in by a portion of the hilly range round the town and is consequently very hot. It contains a large population, principally Indians. Moka has no coast line; still there is a good deal of marshy land in this lower portion.

## II. COMPARISON BETWEEN FEVER AND NON-FEVER DISTRICTS.

In malarial countries the soils which have been found especially to give off malaria, are—

1. Marshy lands.
2. Freshly-cleared forest lands.
3. Loose soil, with or without much apparent vegetable life, resting on some impermeable rock, so that the moisture which lodges in it is given off by evaporation, and as it cannot pass away into great depths of soil, and so leave the loose porous upper crust with its vegetable debris to dry up, so this upper layer is always more or less moist.



The two factors necessary in such soils to get up malarial disease are—

1. A certain amount of moisture.
2. A certain height of temperature.

In Mauritius all the soils above mentioned existed, and in 1866-67 the two factors required to produce malaria were found. The marshy lands were *not* the spots where the fever was most prevalent and severe; it is the third variety of soil which exists in most abundance in Mauritius, and such soil was found on the west coast from the northern end of the island to the Morne in the south. This presented the universal characteristic of being loose, of slight depth, resting on rock, impermeable to water, and the whole of this soil has for years been receiving the drainage and all the filth carried down from the higher inland parts, filth arising from decomposing vegetable matter; and filth arising from the washing down by rain of inhabited lands covered with human excreta and discharges of all kinds. The sea bottom too is composed in many places of a sort of mud, of sand, and organic material in a state of decomposition, which is not removed by the currents, but remains undisturbed in the shallow and quiet waters which are enclosed and protected by the land on one side, and by the coral reef on the other. The difficulty consists in separating the true causes of the fever out of the profusion of unhygienic conditions which abound in Mauritius. We think too much has been made of mere dirt and unsanitary conditions about Port Louis and its neighbourhood. No doubt foul smells and want of drainage are all bad, and all either cause disease, or assist in increasing the mortality, but it is not to these elements of disease that we must look for the predisposing causes of the malarial fever, for it was as severe as possible at the post of Black River; indeed, much more so among the men and officers than in Port Louis; yet this post has no Indian villages near. Its only fault consists in its being situated on flat alluvial soil, probably formed from debris brought down by the river, which is close to it. The quarters are placed well apart, and the water supply is good; its soil, therefore, with the hot and close situation, are alone to blame as the agents in causing the fever. At first sight one would regard the station as a healthy and pleasant one; indeed, sickness amongst the men stationed there was formerly rare, though it was far hotter than Port Louis, being much more hemmed in by mountains, and having far less movement of air. The Bay of Black River has a firm hard bottom of a most intimate mixture of vegetable debris, and mud brought down and deposited by the river, and it is not for nearly three-quarters of a mile from the shore, seawards, before the ordinary coral and sandy bottom is met with. Were this to be upheaved and exposed to the sun, malaria would certainly be given off, and it is just on such a soil (which has been elevated above the sea level long ago, as proved by the presence of an old coral reef now on dry land) that the post is built. An indiscriminate onslaught on all antihygienic conditions can only end in disappointment, for were Port Louis to be drained to-morrow, it would not of itself prevent fever; it will only be by thorough surface drainage of the flat lands near it that fever will be kept off, and this, from the level nature of the soil, will be very difficult to accomplish. There was some prevalence of fever in elevated parts of the districts which seemed unlikely to be malarious but in these cases, the malaria arose from the exposure of vegetable mould to the direct rays of the sun, by the cutting down of forests; there is little doubt but that this was in some places the origin of the malaria. The actual marshy land was certainly not the most malarial, as much of it we find in the high central parts of the island.

The following Table gives a correct idea of the prevalence of fever in the different districts of the island during the month of April, and first week in May, 1867:—



Average Daily Percentage of Deaths.	April.	First Week in May.
Port Louis .. .. .	183.9	202.7
Pamplemousses .. .. .	50.7	43.5
Black River .. .. .	24.0	20.1
Rivière du Rempart .. .. .	19.2	15.1
Moka .. .. .	11.2	11.1
Plaines Wilhems .. .. .	7.6	8.4
Flacq .. .. .	4.7	9.8
Grand Port .. .. .	2.7	4.7
Savanne .. .. .	1.6	2.0

The three last on the list, and most certainly the two last, may be said to have been free from fever, as in these districts the deaths from fever during the epidemic were, if not less than in corresponding periods of 1865, at all events but equalled the mortality of that year. No doubt many of the fatal cases reported were of people who had come from the fever districts. (Again, the comparison with the lower portions where the disease was most deadly. <sup>A</sup> upper parts of Plaines Wilhems and Moka were slightly, if at all, touched in line drawn from the Ile d'Ambre on the north-east to the Morne on the southern end of the island, would separate the fever districts from the healthy ones, the former being on the west, and the latter on the east side. The deaths occurred among about half of the population, so that these deaths calculated in relation to the whole population of Mauritius would not at all represent the true rate of mortality.

## II. COMPARISON OF FEVER WITH HEALTHY DISTRICTS.

Fever Districts.	Healthy Districts.
<sup>as</sup> <ol style="list-style-type: none"> <li>1. Mostly on leeward side of the island.</li> <li>2. More densely populated.</li> <li>3. Temperature higher.</li> <li>4. Sheltered from prevailing south east wind by inland mountain chains and other high ground.</li> <li>5. Soil densely charged with decaying vegetable and animal matters, also the bottom of shallow sea lying between shore and reef; the water nearly all along the coast has little motion, refuse, in consequence not being washed away, accumulated at bottom or cast frequently back on the shore.</li> <li>6. Extensively cultivated but <i>not</i> drained; scarcely any forest land.</li> <li>7. Smaller rainfall.</li> <li>8. More stagnant water and marshy land, and much of this dried up during the past season.</li> <li>9. The hills and slopes from them do not run direct to the sea, but terminate in a varying extent of flat land, derived in many parts on the coast from filling up of muddy bottom of sea.</li> <li>10. Less drainage by rivers, many of which have become almost dry during past years.</li> </ol>	<ol style="list-style-type: none"> <li>1. On windward side of the island.</li> <li>2. Less densely populated.</li> <li>3. Temperature lower.</li> <li>4. Fully open to prevailing winds.</li> <li>5. Soil not charged with such an enormous amount of decaying organic matter, and sea between reef and shore deeper, and bottom cleaner from constant movement of the water, by which refuse is removed and carried off.</li> <li>6. Less extensively cultivated, and a considerable amount of forest land remaining.</li> <li>7. Much greater rainfall.</li> <li>8. Very much less stagnant water; and marshy ground from greater rainfall, almost always covered with water.</li> <li>9. Hills run more directly or by steep slopes down to the sea, thus leaving a less extent of flat ground.</li> <li>10. Greater drainage by rivers, which are more numerous, and have a larger volume of water and are more rapid.</li> </ol>



But one break occurs in this long fever-stricken strip of land, and this is, at the military station of Cannonier's Point, which, as far as soil and situation on the sea shore is concerned, bears a marked resemblance to the post of Petite Rivière. It may be useful to compare these two, and also the station at Black River, all being on the west coast. Petite Rivière station is placed on sandy soil, not far from the Port Louis range of hills, and receives drainage off a large portion of country. Black River station is placed on a flat piece of ground formed of the mud brought down by the Black River, and by the rains from the high hills, which closely hem it in to windward. In these two districts the fever raged with great intensity. Cannonier's Point station is placed at the extremity of a sandy spit, which juts out into the sea, and is separated from the slopes running down from the hills by a broad flat sandy plain. It consequently has not been charged with vegetable debris brought down from the higher lands. Moreover it is a very long distance from these hills, and the movement of air in consequence is free. There was no fever here, though within a radius of a mile or so it prevailed extensively. The detachment 2nd Battalion 22nd Regiment occupied the post until about the end of February, no case of fever showing itself among them, although it was raging furiously all round. The soil of the post is mostly coral sand, and is remarkably clean and free from damp decaying vegetable matter.

#### GENERAL CONCLUSIONS ON THE CAUSATION OF THE FEVER EPIDEMIC OF 1866-67.

1. That for years there has been a steady accumulation of organic debris washed down from the loftier parts of the island, and deposited in the lower and level lands, which are formed, as already stated, of a shallow upper layer resting on an impermeable rock, and consequently evaporation is the sole way in which the moisture can be got rid of.
2. That, as a rule, during the season, when the temperature is highest, there is abundance of rain, and more especially towards the end of the hot season.
3. That in the season 1866-67 there was little or no rainfall, and the temperature was very high, and kept up for a much longer period than usual.
4. *That the places that suffered most from fever were, par excellence, those which are always hotter and dryer than the other parts of the island.*
5. That many other places which did not suffer from fever, yet presented all and other conditions like those which did suffer, but were distinguished by having a lower temperature and a greater rainfall.
6. That in the majority of instances the malaria was developed, not in actual marshy ground, but in the thin, porous soil above alluded to; and that, in cases where the fever occurred at a considerable elevation above the sea, it was due to the sun's rays acting in a very dry and hot season on the soil charged with vegetable matter, exposed to its influence by recent cutting down of forests and underwood.
7. That the mere accumulation of filth of all kinds in the densely-inhabited districts had no influence whatever in the origin of the fever, as it was almost as fatal in the sparsely-populated country districts (as Black River), as in the dirty and densely-peopled districts (as Port Louis).
8. That it was entirely of malarious origin, and in every form, we might say, perfectly curable by the administration of quinine in large doses; but that, from the intense character (or amount of malaria), the fever, if untreated, rapidly produced a low and depressed state of system, by which the great mass of the deaths were caused.
9. That the "bilious remittent," and other such forms, were complications mixed up with the fever, and due in most cases to prior attacks of fever, or to long exposure to a powerful malaria, and that such low cases were not seen amongst the soldiers, owing to the fact that they had the advantage of having their attacks treated by full doses of quinine and stimulant treatment of various kinds, consequently it is unnecessary, nay, untrue, to suppose the fever to have been anything more than a malarial fever, whose danger depended chiefly on want of treatment and proper food, unless the absurd proposition is held that it differed in very important particulars, according as it attacked civilians or military.



10. That it was not in the slightest degree contagious.

11. That the so-called "Bombay fever" of Mauritius merely means a fever especially prevalent amongst Coolies, who had come from the Bombay Presidency, and that it was in past years for the most part confined to them; that this was a malarial fever, occurring in a people who had come from a malarious country, and whose constitutions had been malarialised there, consequently we can suppose a very small amount of malaria (or exposure to a lower temperature than usual) would cause relapse of their old complaint, but which was not sufficient to give fever to those who had never before suffered from the effects of malaria, and it was amongst those already malaria-poisoned and others who had had repeated attacks of fever unchecked by medicine, that the more serious kinds of fever were found, such as much bilious vomiting, yellowness of skin, &c.

12. The actual direction of the wind did not have much influence in actually carrying the miasm at the time, for the winds were all local and varied in different parts of the island.

13. That the whole and sole cause of the outbreak of fever in an island hitherto almost free from it, was excessive heat, with drought, acting on a soil which had, as it were, been accumulating the elements of malaria, and only waited for the exciting causes to set it free, and moreover, owing to the absence of rain, the hot season more resembled the hot season of tropical climates, as India, &c., than heretofore has been the rule; as in Mauritius, the hot and rainy seasons were synonymous terms, but this season, owing to the absence of rain, a continuous hot season, resulted; in other words, in Mauritius hitherto the rain has acted as a preventative of malaria, this coinciding with the fact that even this season those districts, which as a rule are most rainy and coolest, were free from fever.

14. It may be noted, too, that basalt, of which the island is chiefly composed, is a rock which absorbs heat, and parts with it very slowly, hence a higher temperature may be kept up in the soil even during the night, than the temperature of the air; and, further, we may note that a considerable portion of the soil is ferruginous, as is markedly shown in the district of Pamplermouses, one of whose cantons, "Terre Rouge," is so called from the colour of the ferruginous soil.

### III. HISTORY OF THE BATTALION IN RELATION TO THE FEVER.

It is necessary to go back for a few months of the year 1866, in order to include the whole hot season of 1866-67. The battalion came to Port Louis from the various detachments on the 12th July, 1866, and remained in the Line Barracks for the rest of the year. During this period the number of cases of ordinary fever (continued fever and febricula) admitted were—2 in July, 0 in August, 2 in September, 2 in October, 3 in November, 28 in December; and of "enteric fever" there were 5 admissions; 3 men died within the period, viz., 1 enteric fever, 1 peritonitis (amyloid degeneration of kidneys), 1 hepatic abscess and dysentery.

The first case of fever entered as intermittent occurred on the 18th October, and the first batch of cases indicating a greater than usual prevalence of fever commenced on the 23rd December. Most of these cases, and those occurring for some weeks after, were entered as "febris continua," but seeing that such cases greatly increased in number, and that later decided symptoms of intermission appeared, it is highly probable, nay, we think certain, that all were due to the same disturbing agency, viz., malaria, and this would seem to lead to the generalization that the ordinary febricula (fibris c.), always more or less prevalent in the hot season, especially at Port Louis and its neighbourhood, has always been due to malaria, which this season became so much more powerful or concentrated as to produce a greater effect, viz., the fierce malarial fever of 1867.

\* *Bombay Fever*.—Surgeon-Major Small, writing from Mauritius on July 18, 1868, states that two distinct fevers have been included under this term, viz.: true *enteric fever*, with the characteristic lesions in "Peyer's Patches"; and ordinary *malarial fever*: though in cases of the former disease, the *post mortem* signs of malarial fever were in many cases superadded.



1867. *January.*—There were 37 admissions for continued and intermittent fever, and two for enteric fever. The deaths were 3; one man from enteric fever; one woman, ambustio; one child, neglected dysentery. Hitherto, though there were a great many cases of fever prevalent among the civil population, and the deaths were considerable, yet no great alarm was felt, especially as the rains which had been expected would probably not longer be delayed. The heat during the month was very great, the breezes slight and local, and the rivers very low.

*February.*—The admissions were 93 for continued and intermittent fever, and two for enteric fever; the deaths were three—two men, chronic hepatitis and dysentery; one child, dysentery. Each day of this month the fever increased in intensity, and the deaths among the civil population were very numerous. The many military guards about the town, furnished by the Battalion, were removed, thus reducing the night duty to a minimum, and the men were strictly kept in the barracks and verandahs during the heat of the day. The anticipated favourable change in the weather and the long-expected rains did not appear, and the poorer parts of the town and suburbs began to look empty and lifeless. On the 15th of this month some 40 sick and convalescents (not from fever only) were sent down to Cannonier's Point, in order to make room in the hospital for the increasing numbers of fever cases; as, besides our own, we had the sick from three detachments of the 22nd Regiment. For this purpose the detachment 22nd Regiment there stationed was removed to Flacq, and the whole of the large quarantine establishment placed at the disposal of the military authorities as a convalescent station: from time to time, until the end of March, this drafting of convalescents continued to Cannonier's Point. As far as we can at present say, there appears to have been no case of malarial fever, which took its origin at this post; but as in the neighbourhood the disease was very prevalent, it is extremely difficult to find a case in point, viz., of any one who had remained at the station without going into the malarial districts; but as will be seen hereafter, the number of admissions, for relapses of fever, were fewer than at other stations.

*March.*—The admissions for malarial fever were 310, and this (owing to the detachment of convalescents sent to Cannonier's Point) out of a smaller number of men, no admissions for "enteric fever," this month, there were three deaths—one man from enteric fever, one man from heart disease, one child from malarial fever. To the end of March there had been no deaths in the regiment, except of one child, which could be attributed to the malarial influence. The deaths among the civil population were now terribly large, and the town and its neighbourhood presented a very different aspect to the usual busy, crowded scene. The wharves and quays almost deserted, the usually large number of carriages and carts had vanished, and from the death or flight of the inhabitants to other districts, the small huts or houses forming so large a portion of the town and its suburbs were left untenanted, while a few gaunt, fever-stricken shadows—Indians and Creoles—with handkerchiefs bound round their heads, might be seen here and there drowsily reclining under the shade of a tree. The change from the usual noisily busy scene to one of such stagnation was extremely painful, and not relieved by the numbers of funeral trains constantly passing along the roads leading to the cemeteries.

*April.*—It was thought necessary to remove the battalion out of the infected town; consequently, on the 1st of April, the head-quarters, numbering 391 men, 24 officers, 42 women, and 70 children, proceeded by steam to Flat Island, the quarantine establishment for cholera. This island is situated to the north of, and distant about six miles from, the nearest point of Mauritius. It is composed, in great part, of nearly level ground, rising at its western extremity into an irregular hill composed of volcanic ash, and containing fragments of coral and of lava (basalt), in fact the remains of a small crater. From the hill a broad lava stream (now basalt) flows by a gentle slope to the northern extremity of the island, where there is a detached mass of basalt called the "Pigeons'-house Rock," from its honeycombed appearance. The rest of the island (about one-eighth of its area), is composed of fine coral sand, with occasional blocks of coral. On the eastern side this sand forms a high, broad, grass-covered bank, with a steep slope to the sea-shore; and another, less inclined, towards the centre of the island, rising again as it approaches the basaltic portion, thus



forming a small valley. On this bank were placed most of the tents in which the men and officers were lodged. Proceeding westward, and crossing the small valley, we meet with an encampment for married people; and ascending by a gentle slope, the two hospitals are reached, built one of stone, the other of wood, on a small spur of the hill, and at some elevation above the sea. Descending from these we reach a small bay, from which a pier projects, on the shore of which are placed twelve wooden huts, for the accommodation of the coolies when in quarantine. Six were placed at our disposal, the remainder, at about 300 yards distant, being occupied by 200 Indian and other convicts, with their guards. These huts are mere sloping roofs, placed on low walls about two feet from the ground; no windows, but with a door at each end; no flooring, the ground being sand and rather damp, and almost on a level with the sea-shore. The only means of access to the island are by—first, the pier on the west coast, which, owing to the usually heavy rollers, can seldom be used; and, secondly, by a pass through the reef on the east coast. This is a narrow and very shallow gap, so that only boats of small size, about 12 to 14 tons, can get through; and from its situation, *i.e.*, facing the south nearly, it is often closed when a strong wind is blowing from the prevailing quarter, the south-east, and in very calm weather it is frequently impracticable on account of the heavy swell coming up from the west. A small island (Gabriel Island) lies to windward and at a short distance, the two being connected together by a reef, the sea between being very shallow. The drinking water was obtained from a Normanby's distilling apparatus. The few wells in the island, from their being placed on the coral sand soil, were very brack. Some tanks for collecting rain-water were attached to the hospitals and at the huts. The weather remained hot for some ten days after our arrival; and owing to the amount of necessary fatigue work, in unloading stores and carrying them to the camp, a very large number of men were laid up with fever. About the middle of the month there were some heavy rains, with strong and cool south-east winds, indicating the commencement of the "trades" and the cool season. Its effects were seen in the number of cases of dysentery, which in Mauritius is usually most prevalent at the end of the hot season; and owing to the strong wind, no communication for several days was possible with the mainland, so that only very hard biscuit was issued to the healthy and sick. Fresh meat was issued every day to sick in hospital, and daily to nearly all out of it. Unfortunately, also, our supply of quinine ran out, but this only for a few days; and these various difficulties harassed us till the battalion returned once again to Port Louis on the 23rd of May. At first the sick were placed in the two hospitals, but as the numbers increased two of the huts on the coast were for some time used, the other four being occupied by married families, four in each; but being found so very unhealthy, were after a time given up, and a small wooden building (attached to the hospitals, and formerly used as quarters for the Indian civil hospital attendants), a hospital marquee, and several bell tents substituted. In addition, at the main encampment, a tent was set apart with an orderly to look after it, and supplied with a few drugs. At this tent the morning sick were seen at 6 A.M., and convalescents at 11 A.M. Only such cases were sent to hospital as absolutely required it, the remainder being treated in camp. By this means the sick were saved the long walk to the hospitals, so the admissions to hospital must be at least doubled to give any idea of the amount of sickness. The loss of life was very great among the children, chiefly from want of proper food, such as milk, which could not be made up for by wine or brandy. They died principally from bowel affection. The dysentery which attacked us here was of a far worse form than the usual dysentery of Mauritius (for full account, *vide* Appendix I.), and the great difficulty we had to contend against was want of proper food, so important an element in the treatment of this disease. Latterly, bread was made by the men in the island, a welcome change to the stale, mouldy bread and hard biscuit which had hitherto been supplied. When the dysentery increased, it became evident to us that it would be far better to face the risk of relapses of fever at Port Louis, where proper food and comfort would be procurable, than to remain in Flat Island, especially seeing that the cool season had commenced, and consequently that the malaria was disappearing; and after urging this change as strongly as possible, the headquarters returned by steamer to Port Louis.



The admissions to *hospital* during this time (30th March to 24th May) were, amongst the men, malarial fever, 292; dysentery, 49. Percentage of admissions: malarial fever, 76.54; dysentery, 12.84. But, with the exception of 20 men, all had had several attacks of fever, and *all* the women and children were ill with it or dysentery. The officers also suffered severely: one was invalided home from Flat Island, and two others on the arrival of headquarters in Port Louis. The most serious case was that of a young officer who had an attack of genuine enteric fever, complicated with occasional attacks of malarial fever.

The deaths were 10 men, viz.: 4 from malarial fever, 5 from dysentery, and 1 from ebrietas and malarial fever. Percentage of deaths: malarial fever 1.048; dysentery, 1.310.

One woman died from dysentery, and 13 children from dysentery and from asthenia after fever. Three men with dysentery were left behind, as they were too ill to move: one came to Port Louis shortly after, the second died at Flat Island, and the third in Port Louis after we had left for England, and are not included in the above death list. We may notice, in conclusion, that not one of the inhabitants had fever, except such as had been on the mainland.

*Port Louis again.*—From 23rd May to June 7, the health of the battalion rapidly improved, especially those whose state had been the most serious, viz., the dysenteric patients, so that for the week ending 7th June, of a strength of 645 men, there were 2 admissions for fever, and 9 remaining; no admissions for dysentery, and 22 remaining; while about 130 men were convalescents under treatment with quinine at the barracks. During this period (23rd May to 7th June) there were 8 admissions for malarial fever, and 12 for dysentery, and no deaths. Of these dysenteric cases, 3 were cases which occurred in last week in May in Port Louis detachment; the remaining 9 contracted the disease at Flat Island, but were not at once admitted.

The battalion embarked for home on board H.M.S. "Himalaya" on the 7th of June.

Before proceeding further with the history of the battalion it will be desirable to give a short account of those men of the regiment who were stationed at Cannonier's Point since 16th February, and at Port Louis during our stay at Flat Island.

*Cannonier's Point Detachment.*—From 16th February to 31st May the average strength was 164. The admissions were: 142 malarial fever, seven dysentery, and one diarrhoea; the percentage of admissions, 86.5 malarial fever, and 0.42 dysentery; the deaths were, two malarial fever, and one dysentery; percentage of deaths, 0.61 malarial fever, 1.22 dysentery. The greatest number of admissions for malarial fever occurred towards the end of April, and of dysentery, very end of April.

*Port Louis Detachment.*—From 30th March to 17th May, the average strength was 70.3. The admissions were: 78 malarial fever, and none of dysentery; percentage of admissions, 110.95 malarial fever and none from dysentery; the deaths were two from malarial fever; percentage of deaths 2.844 malarial fever.

Thus comparing the three stations of Port Louis, Cannonier's Point, and Flat Island for the seven weeks from 30th March to 17th May, we get the following:—

	Flat Island.		Cannonier's Point.		Port Louis.	
	Percentage of		Percentage of		Percentage of	
	Admissions.	Deaths.	Admissions.	Deaths.	Admissions.	Deaths.
Malarial fever .. ..	75.03	1.068	53.80	0.4723	110.95	2.844
Dysentery .. ..	9.078	0.801	1.890	0.9446	..	..
Average strengths ..	374.5		211.7		70.3	



With regard to the above percentage of admissions it must be borne in mind that, owing to want of hospital accommodation at Flat Island, the percentage of admissions is much less than they would have been had all, as at Cannonier's Point and Port Louis, been admitted, indeed the percentage at Flat Island ought to be doubled.

*On Board H.M.S. Himalaya.*—From 8th June to 25th July, after a fine voyage, including stoppages at Algoa Bay, Simon's Bay, St. Vincent's, Madeira, and Queenstown, the battalion disembarked at Portland on the 24th and 25th July, four companies proceeding to Weymouth and the head-quarters to the Vern Citadel, Portland. The relapses of fever during the voyage were of course very frequent, and generally increased as the thermometer fell. The rations on board were excellent, and also the accommodation generally; but the sick bay was far too small, and the accommodation for sick women not very good, no close stools being allowed to be used; the women suffering from dysentery had to ascend a long flight of steps to the water-closet; this, however, was remedied after a time, the cabin for lying-in women having been given over to them.

The deaths in the battalion during the voyage were four men, two phthisis pulmonalis, aggravated or excited by repeated attacks of fever; one asthenia after fever, probably from embolism of heart; one suicide by drowning; two children, one malarial fever, and one dysentery. Much to our regret no *post mortems* could be held, as no possible place for such a purpose could be found on board the ship.

*At Home from 26th July to 31st December, 1867.*—Four full companies have during this time been stationed at Weymouth, where they are employed on engineering works, while the remainder, the head-quarters, have occupied the casemated barracks in the Vern Citadel on Portland Hill, where the duty entails a considerable exposure to cold, as there are a large number of men employed daily on picquet duty, the sentries being placed on very exposed situations to overlook the convicts at work.

The total number of relapses from fever among the men from 3rd August to 31st December, 1867, have been at Portland only 705.

The average daily number of relapses, 4·669; the daily percentage of relapses, 1·319; the average daily strength having been 352·81; officers at Portland have been 35; occurring in officers, 6; average strength of officers during period, 16·5; total number of relapses among women and children at Portland: 125 in 18 women, and 94 in 14 children.

*Causes of Relapses.*—Authorities on the subject have given a great many causes for relapses, but most of them seem rather of the *post hoc, ergo, propter hoc*, argument, and many seem very unaccountable, such as a heavy supper of lobster or crab being the cause of a fit of ague. From the 28th of August (and still being carried out) a series of meteorological observations have been made, viz., those derived from the wet and dry bulb, the maximum and minimum thermometers, so that the daily amount of humidity, the mean daily temperature, the highest and the lowest temperature in the 24 hours have been ascertained; with this a daily register of the number of fever relapses, calculated according to the strength of the regiment on that day; this has been necessary owing to the fluctuations in strength from men going on or returning from furlough. To give a few examples of the effects of a fall of temperature in increasing the number of relapses, we may select the following:—

On September 25th, the daily percentage of fever rose high; the temperature had fallen suddenly, and from being damp and warm, had become dry and cold.

On October 10th, with a fall of temperature, the percentage of relapses rose from 0·83 to 2·0 and 2·6 for a few days.

On November 17th and 18th, thermometer fell below freezing point, and percentage of fever relapses rose quickly.

On December 3rd, the temperature fell to 23° Fah., and this was followed by a great increase of fever cases.

The above examples are sufficient, we believe, to show that these observations have been accurately carried out day by day, and the general conclusions we draw from them are: 1st. That undoubtedly so far as we have carried



out these observations, *i.e.*, for a period of 151 days, the main cause of relapses of this fever, is a sudden fall of temperature. 2nd. That after the temperature has fallen and remained low, the relapses of fever fall to their usual number; in other words, that it is the effect on the body of a sudden fall of temperature which causes the relapses, and that if the temperature continues low, the number of relapses remains steady day by day, and about the same in number as when the temperature is warm. 3rd. That the amount of humidity or damp has no effect whatever on the relapses of fever; for we had numbers of thoroughly wet days with no increase of fever relapses, provided that the temperature remained steady; in other words, that what is called damp close weather, is unfavourable for causing relapses of fever.\*

We venture to think these remarks are useful, as placing the causation of relapses of malarial fever, on the more certain basis of actual daily observation of those alterations of temperature which have so much effect on everyone. From our observations at Flat Island, we saw how powerful was exposure to fatigue and sun in causing the actual appearance of malarial disease in men who had been previously exposed to the influence of the poison, and now we find that the sudden fall of temperature has also a powerful influence in causing repetitions of those signs, of former exposure to malarial poison, which we call malarial fever.

In the detachment of the battalion stationed at Weymouth there are as many as 577 cases returned as relapses of fever "requiring quinine," out of an average strength of 189, *i.e.*, 2'0 per cent. daily (a much larger proportion than we show at Portland), as the men stationed at Weymouth have little or no night duty to perform (about 30 nights in bed), and the daily amount of fatigue performed on the engineer's works is not very hard; we can only conceive as the cause, that the doses of quinine were not, perhaps, sufficiently large and repeated to lengthen the interval between the relapses.

In concluding the history of the battalion, in relation to the dangerous malarial fever through which it passed, we may point out that since our arrival in England, the regiment has been performing a fair amount of hard work, as on the works at Weymouth, and guards and picquet duty at Portland; and that as a rule, and with few exceptions, no cases of relapses of fever have been actually taken into hospital, treatment with quinine for two or three days rendering them fit for their duty. A greater triumph altogether of actual curative medicine can scarcely be given than in the simple treatment which was adopted for a disease which carried off thousands of civilians, and which resulted in our bringing home this fine battalion with a loss of but few men, and with strength to perform the amount of duties they have been set to since their arrival in England.

#### IV. A GENERAL ACCOUNT OF THE FEVER.

In the following remarks all cases of fever, whether "continued," "intermittent," or "remittent," are classed together as malarial fever, of course not including any secondary fever, nor enteric or other determined specific fevers.

*Symptoms.*—Before speaking of the peculiar symptoms of the varieties of malarial fever, a few words on the more prominent signs of the fever generally are here given; they are founded on 396 cases, which were recorded regularly; afterwards the amount of work was too great to permit us to do more than take rough notes at the time of the most noteworthy circumstances.

*Vomiting.*—Out of the 396 recorded cases, in 132, or 33'33 per cent., vomiting was present, and in 264, or 66'66 per cent., vomiting was absent, and about the same proportion occurred subsequently: it was also remarked that certain men always vomited during the cold stage in all their attacks of fever while in others vomiting never took place; the matters vomited were the contents of the stomach; sometimes a little bile, but not much, or else dry retching, was only present.

\* Up to the present date, *viz.*, 1st July, 1868, these observations have been continuously carried out, and with the same result, *viz.*, that a fall of temperature was always followed by an increase in the number of fever relapses; mere dampness having nothing to do with this result.



*Condition of the Bowels.*—Out of the 396 cases, 32, or 8·09 per cent., had looseness of bowels, while in 364, or 91·91 per cent., the bowels were regular, and in only a very few cases was there marked constipation.

*Delirium* occurred in very few cases indeed.

*Cold Stage.*—Out of 304 recorded cases, in 56, or 18·42 per cent., there was no cold stage, and in 248, or 81·58 per cent., it was present; but as the epidemic increased in severity, there were but few cases without a cold stage of some sort.

*Varieties of Malarial Disease.*

1. *Continued Malarial Fever* { A. Mild form.  
B. Severe form.
2. *Intermittent do.* do.
3. *Remittent do.* do., including the so-called "bilious remittent."
4. *Malarial Collapse.*
5. *Malarial Cachexy*, with the degeneration of tissues resulting.

1. *Continued Malarial Fever.* (Two varieties, viz., A mild, B severe, form).

*A. Mild Malarial Continued Fever:—*

*Remarks.*—We have already remarked on the greatly increased number of cases usually called "continued fever," or "febricula," which occurred at the commencement of the hot season of 1866-67, and which occurred later after cases of intermittent fever were plentiful; it seems, therefore, not unreasonable to suppose the same exciting cause, viz., malaria was at work in these cases as well; but that the symptoms were milder and less decided from the smaller amount of poison taken into the system, or rather from the fact that the malarial poison was at first of less intensity, and as we know that in very severe malarial fever no signs of intermission and remission may be present, so it seems a not unfair generalisation to suppose all cases of "febricula," such as occur in the unhealthy seasons of hot climates, to be due to a small dose of the same poison, which, in large doses, can completely prostrate as though by a blow, with a severe continued fever. This view coincides with Dr. Parkes's observation, that "when a climate is called unhealthy, in many cases it is simply meant that it is malarious."

*Symptoms.*—These ordinarily observed in febricula, heat of skin, thirst, tongue but slightly furred, pains in limbs; its natural termination is in a profuse sweat on the 3rd, 4th, or 5th day. In three cases in which the temperature was taken there were nightly exacerbations till the highest point was reached, and then one sudden fall to the standard of health, on which convalescence was at once established; in such cases it would seem as though nature was able of herself to overcome or throw off the small dose of poison, so that no subsequent repetition of the attack took place till fresh exposure to the poison.

*B. Severe Continued Malarial Fever:—*

*Remarks.*—Very few marked cases of this dangerous form appeared in the battalion, but it occurred more frequently among the civil population; the attack is most usually sudden.

*Symptoms.*—No intermission nor remission, early delirium; tongue becoming very rapidly furred and dry, and feebleness of pulse commencing soon; vomiting is very generally present; this condition, if not at once relieved by large doses of quinine, passes into a state of coma, with dilated pupils, &c., and then death.

*2. Intermittent Malarial Fever:—*

*Remarks.*—The vast majority of cases of fever in the battalion was of this form, and the ordinary type was the *quotidian*, next in frequency the *tertian*, the *quartan* being very rare.

*Symptoms* exactly as laid down in books on the subject; the main symptoms have been already referred to at the commencement of the account of the fever.

*3. Remittent Malarial Fever:—*

*Remarks.*—Comparatively few cases of this form occurred in the battalion, and none until the head-quarters were sent to Flat Island, and there nearly all our cases appeared, and seeing there was no malaria present in Flat Island itself, its occurrence must be attributed to the effects of hard work and ex-



posure to the sun, with indifferent food, acting on men who had been exposed to the influence of malaria; this remittent fever, as also the "bilious remittent," are unfortunate terms, for most assuredly these terms were used very loosely, the former to mean a severe fever in which the three stages were confused or wanting; in fact, most were cases of the "severe continued malarial fever;" the latter we believe to be simply cases of malarial fever, in persons whose previous attacks had been neglected, or who had had many previous attacks of malaria in former years, and this form occurred especially amongst Indians and others who had of course been malarialized in their native land before coming to Mauritius; no such cases of excessive bilious vomiting occurred in the 13th Regiment. When it is stated that "remittent fever," or "bilious remittent fever" occurred largely in the civil population, little more information can be derived from these terms than, that amongst them, the fever was complicated by neglect, want of proper food, and especially of quinine, &c.; great numbers of those who were found dead in houses or elsewhere, died of what we shall present refer to, viz., "malarial collapse;" in other words, the word "remittent" did not, as it ought, refer to a fever with remissions instead of intermissions, but merely meant severe neglected fever arising from malaria.

The symptoms were so much the same as usually laid down, that it is unnecessary to take up space in describing them.

#### 4. *Malarial Collapse*:—

*Remarks.*—By this term, we mean a state of profound anæmia, from the blood poisoning effects of malaria; the symptoms come on with little or no warning. A patient has had one or more attacks of malarial fever (the fever itself having not been necessarily severe); instead of convalescing as usual, the patient became weaker and unable to walk, and so on; the appetite might be fair; tongue was clean, though pale; in fact, no marked symptoms of any kind beyond a general debility and weakness; suddenly, after having, perhaps (though not at all as a rule) complained of slight cramping pains in the muscles of the legs, the patient apparently goes to sleep, and if observed shortly after is found in a state of profound coma, with pupils dilated (more or less widely, according to the length of time he may have been in this comatose condition) gently breathing in slight gasps (not stertorous) body and extremities cold, pulse weak, or not felt at all. The cases of this form which occurred in our regiment were of men, who having shown for some time no signs of fever itself, were not treated with quinine, as we were compelled for a short time to husband our stock of this drug while we were at Flat Island, and it was only there that such cases occurred; cases, however, such as these formed a very large, indeed the chief proportion of fatal cases amongst the civil population; men laid down, this coma came on them, no one near to give the full dose of quinine, death inevitably resulted; nature in such cases being powerless to heal, they passed slowly from this death-like state of coma, without at any time regaining sense, into death itself; this form is quite distinct and far more deceptive than those cases of "severe continued malarial fever," which, however, if unchecked, pass through this stage of coma on the road to death. This form of collapse, not immediately following severe malarial fever, has been, as far as we can ascertain, not noticed prominently in such works on the subject as we have been able to consult, and as its recognition is of truly vital importance, it may be as well to dwell rather more in detail on it, and give such cases as occurred in the regiment when at Flat Island.

*Case 1.*—Private W. Travers, age 23, service 4 years, a healthy-looking young man who had had several slight attacks of ague in Port Louis (as was only found out after his death). He had been attending at the hospital tent in camp at Flat Island from 12th to 18th April, for a slight attack of ague, and was treated with arsenic; but though he lost the fever he got weaker, and was taken into hospital on the 18th. He had no return of fever while in hospital, and appeared to be doing well, but was very weak. He was treated with diuretics, and had 6 grains of quina given him on the 21st. On the morning of the next day he was insensible and comatose, having but half an hour before asked the orderly to rub his legs, as they felt a little cramped; then turned round as if to sleep. No one noticed his condition until at 7 A.M. (half an hour afterwards) when the Medical Officer found him cold and comatose, with dilated



pupils, and breathing in gentle puffs or gasps. Wine and brandy, &c., were given him, but no quinine; and he passed slowly away shortly after.

*Sectio cadaveris*, 6½ hours *post-mortem*.

*Body*, not notably emaciated; no congestion of body more than a little of the usual *post-mortem* congestion on posterior aspect.

*Brain*, some little blood in veins, but no effusion.

*Spleen*, four times its natural size; soft, pulpy, and full of blood.

*Liver* healthy, but dark-coloured.

*Gall Bladder*, full of dark but thin bile.

*Stomach*, somewhat slate-coloured.

*Bladder*, fairly full of light-coloured urine.

*Lungs*, a very little *post-mortem* congestion at very bases, not full of air, and very bloodless generally.

*Heart* healthy; left side no blood, but a small, yellowish, translucent clot, which on pressure yielded yellow serum, leaving a very small amount of solid; right side, some thin currant-jelly-coloured blood, not clots.

*Arteries* (aorta, pulmonary, and femoral examined), quite empty of blood.

*Veins*, a little thin light-coloured blood.

*Case 2.*—Private David Lumsden, age 28, service 8 years, a strong healthy man, attacked at Flat Island on April 19 with intermittent fever. As the case seemed a mild one, he attended at the tent in camp, taking diuretics only. On the afternoon of the 23rd he was found lying insensible on the sea-shore close to the latrines. He was brought at once to hospital, when on arrival was found to be cold and pulseless, pupils dilated, breathing quietly in gasps, quite insensible, and a quantity of thin blood-stained fluid passed involuntarily per anum. Warm brandy and water was given at once, with a 20-grain dose of quinine, which was with difficulty got down. He gradually recovered, and was discharged well on May 2, having taken quina for a few days with stimulants, and subsequently iron.

*Cases 3 and 4.*—These two cases were exactly alike: they were of two men in hospital, convalescing from fever. As the Medical Officer was making his evening round at 9 P.M. he noticed two men in adjoining beds who seemed to be breathing somewhat unnaturally. The orderly and those near reported that they had been fairly well and cheerful all afternoon, and that they were now asleep. On attempting to wake them, however, they were found to be comatose, quite insensible, with dilated pupils and body cold. With some difficulty, 20 grains of quinine was put down the throat of each, a few drops at a time followed by brandy and water, ammonia, and in two hours after a second dose of quina (10 grains). Next morning these men were perfectly sensible, and made good recoveries.

*Case 5.*—A band boy was found two nights subsequently in exactly the same state, and was treated in the same way, but with rather less quina. He also made a good recovery.

The three last cases were men in hospital at the time, who had had no fever for some days, and complained of general bodily weakness, and were treated with acids, iron, and the like, but no quinine.

*Summary of the five Cases.*—The first case would in all probability have been saved if a large dose of quinine had been given him. It was the first case of the kind we had seen, and there having been no fever for some time, recourse was only had to general stimulants; but the result determined us to use quina in the next case, and with what successful results is shown by their recoveries, for undoubtedly had these men been treated otherwise they would have died in all probability by the morning, as was the case with thousands of Indians and Creoles during the epidemic. These cases have the following points in common, viz.:—

1. Weakness and prostration, without fever at the time.
2. Rapid subsidence into profound coma, without any warning.
3. All had been treated for some time without quinine.
4. The main symptoms were the same, viz., coldness of body, dilated pupils, and coma, i.e., no marked lesion indicated, but merely weakness and prostration.

The four treated with quinine and stimulants recovered well; the one treated with stimulants and no quinine died.



Amongst the officers, two young ensigns—one at Port Louis, and one at Flat Island—showed the same state. They were invalided home, and eventually did well, but for a time they were in great danger. Quinine was given in full doses.

*Diagnosis.*—This “malarial collapse,” we think, is to be distinguished from the “severe continued malarial fever,” which, if fatal, shows a somewhat similar termination, as far as symptoms go; but in pure “malarial collapse” there is wanting such signs as foul, dry tongue, sordes on lips, &c. It is easily separable from “insolatio” by state of skin and pupils; and we wish to separate it from the following malarial disease, “malarial cachexy,” in that none of the great alterations of texture of liver, spleen, &c., have as yet occurred.

5. *Malarial Cachexy.*—Most of the men were not sufficiently long exposed to the malarial poisoning to show this to a very marked extent, beyond the usual relapses of fever and general anæmic condition. They were removed from its influence in time for the enlarged spleen to return to its healthy size, without permanent enlargement and hardening, and without serious and permanent damage to any of the various organs or tissues of the body.

*Pathology.*—Before proceeding to make any remarks on this subject, it will be best to give a short account of such fatal cases, in addition to those already given, which were in any way attributable to malarial fever. The fatal cases from other causes, as dysentery, enteric fever, &c., will be given hereafter.

*Case 6.*—Private Joseph Clarke, aged 38, service 8 years, a steady dram-drinker, had been drinking very hard for some time, and was a prisoner for being drunk. No signs of fever on him when seen 1st April, 1867, while on passage by steamer to Flat Island. Before landing, however, he was seized with fever, became delirious, trying to throw himself overboard. After landing he became comatose, and died three days after, *i.e.*, 4th April.

*Sectio cadaveris*, 2 hours *post mortem*.

*Liver*, markedly cirrhotic, dark-coloured.

*Gall Bladder*, full of somewhat inspissated dark bile.

*Spleen*, twice natural size, rather pulpy.

*Brain* and other organs healthy.

*Case 7.*—Private J. Stride, aged 30, service 8 years, a man who had suffered terribly from syphilis, constantly having small secondary sores on neck, papular eruptions, &c., was seized with fever, and died in five days.

*Sectio cadaveris*, 3 hours *post mortem*.

*Spleen*, five times its natural size, and very pulpy.

*Stomach*, a good deal congested.

*Liver*, enlarged, dark, several crucial deep cicatrices (syphilitic) on upper surface of right lobe, grouped together.

*Gall Bladder*, full of dark bile, thick, with fine solid particles.

*Case 8.*—Private J. Dempster, age 36, service 8 years, a man who had often suffered from dysentery, and came to Flat Island still under treatment for it, was seized with fever, and died comatose in 38 hours.

*Sectio cadaveris*, 4 hours *post mortem*.

*Body*, a good deal emaciated.

*Spleen*, three times natural size, pulpy.

*Stomach*, somewhat congested.

Between *liver and diaphragm* and *spleen and diaphragm* was found some soft, yellow, adhesive matter containing pus, about an ounce altogether; no signs of peritonitis existing.

*Heart*, a large, firm, fibrin clot in left ventricle and aorta.

*Large intestines* somewhat thickened, especially near the ileo-cæcal valve, but no ulceration.

*Case 9.*—Private W. Hawkins, aged 30, service 9 years, had a sharp attack of malarial fever, and recovered apparently well from it; but while still in hospital on 17th April, he got suddenly weaker with œdema of right fore-arm and left foot. He stated that he made urine more freely than usual (no time to examine urine); he died unexpectedly on the night of 24th April.

*Sectio cadaveris*, 10½ hours *post-mortem*.

*Body*, much subcutaneous fat about 1½ inches in thickness.

*Liver*, healthy, not dark.

*Stomach*, no congestion at all.



*Spleen*, three times natural size, not markedly soft or pulpy.

*Kidneys*, very flabby, enlarged, granular, and in both small abscesses.

*Ureters*, both enlarged and left bifurcated at a short distance from the pelvis, and entered kidney at a separate place, and then joined the other at the pelvis of gland.

*Heart*, Left ventricle, firm fibrine clot; right ventricle, soft black clot; no fluid in pericardium.

*Lungs*, very little congested, even at bases; both full of frothy liquid; no fluid in pleura.

The main point in the pathology of this disease, is that the blood is poisoned, all subsequent complications or impairments arising from the action of this depraved fluid on the tissue and organs of the body. It seems to have been too much the custom to look upon the spleen and certain organs as being the most affected, it being rather a very prominent lesion; but the pains in the limbs, and general muscular weakness, and a sort of fatuity which follows a severe attack of the fever, all point to impaired function, and probably temporary impaired structure of all the organs and tissues, and consequently to lay too much stress on the treatment of one prominent organ, as the liver, is not sound pathology, as in the case of this fever we have an agent in quinine, which has the power of remedying the depraved state of the blood induced by the malarial poison, and practically this is found to be the case, for the quinine will clean the foul tongue, give strength to the muscles, and prevent the bilious vomiting, without having recourse to remedies such as calomel and the like, which after all, when given, can only carry one outwork of the disease, instead of destroying the main citadel itself, for it must be remembered that we have to do with a disease for which we have a potent and conquering weapon in quinine, and consequently merely to treat prominent symptoms is useless; the case being very different from other diseases where we can only treat the symptoms as each arises.

In discussing the pathology of this fever, we must separate two very different states, viz., (1) cases of death during an attack of fever, and (2) those cases which we have called "malarial collapse."

1. In cases of death during the fever, there is more or less general congestion.

2. In deaths from malarial collapse, as well shown in case 1, we find an absence of blood from the arterial system, and an airless state of the lungs, which are also remarkably bloodless, a condition of profound anæmia exists, the spleen only being gorged more or less with blood. These few signs distinguish the form of the disease, viz., "malarial collapse" from death during the fever, or when the patient is as it were knocked down by it as though by a sudden blow, just as much as do the symptoms during life. It is worthy of note, that in these two very opposite conditions quinine is equally useful; at the risk of being tedious, we feel inclined to dwell on this form of malarial disease, viz., the collapse without fever, on account of the first death having made a profound and painful impression, while the extraordinary manner in which in the subsequent cases the men were literally snatched from the jaws of death. To a person who had never seen such cases of coma from malaria, it would seem almost miraculous to observe the effects of a few grains of quinine. Again, as far as we have been able to consult authorities, this form is not noticed, and our first case completely baffled us, as from the length of time that had elapsed since the last attack of fever, and with the coldness of the body, it did not in the least resemble any form of malarial disease with which we were acquainted personally or through books. This form again is very distinct from malarial cachexy, where death ensues from profound degeneration of various organs, whose healthy condition is necessary for the continuance of life. It seems to us a mistake to look upon one organ as being more attacked by the actual disease than another, but that rather certain organs show the effects of the poison more, thus though vomiting is a very prominent symptom, yet its presence shows nothing more than the pains in the back and limbs, both are due to the same cause, viz., the circulation of a vitiated fluid in the place of life-renewing healthy blood, and the long continued circulation of this fluid leads to changes in the structures of the body which we find in a person suffering from "malarial cachexy." John Hunter



says emphatically "that fatal yellow fever is the death of the blood," so we seem in malarious diseases to have all stages of poisoning up to the death of the blood as seen in "malarial collapse."

*Bilious Remittent.*—No cases of this vaguely termed disease occurred in the 13th, and unless we resort to the supposition that the same cause, viz., malaria in the same town, nay, even in the same street, gave origin to intermittent fever in one case, and to bilious remittent in another, we can only, and we think best, explain the occurrence of this form by separating it entirely from the direct effects of malaria, and attributing it to the result of previous attacks of malaria, *i.e.*, that such symptoms as excessive bilious vomiting, even going as far as blood vomiting, were a complication mixed up with the fever proper, but distinct from it, in other words, occurred only in a person thoroughly malarialized, who was seized with a fresh attack or relapse of fever, a person too whose previous attacks have probably not been treated with quinine. It is only in this way that the discrepant opinions which existed in Mauritius, as to the relative proportions of the different kinds of malarial fevers can be explained, and this form of bilious remittent was seen more specially amongst people whose native land is malarious, such as Indians and others. In very many cases the severity of the disease depended evidently on the question as to how the prior attacks had been treated, whether quinine had been given in sufficient quantity or not, whether mercurialization or blood-letting had been employed or not, whether depressing or stimulant remedies had been used or not. We write this advisedly, as there were some who ignored quinine altogether, some who declared that in *small* doses it answered as well, some who mercurialized and even bled. In conclusion we may state that our short observations, taken at a time of very great pressure of work coupled with illness, only confirm what has been far more ably described before. The chief point we would refer to especially, is that dangerous form which we have called "*malarial collapse*," which apparently hitherto has not been so strictly defined as it might be, and above all the value of the simple quina treatment has been markedly shown in the great experiment which we witnessed when this battalion of young soldiers was for the first time exposed to the full effects of the malarial poison.

The object of our remarks on the pathology of this disease, is to, if possible, strengthen the views of those eminent men who have insisted on the proper method of cure, viz., to attack the disease, *i.e.*, the poisoned blood, and not to waste time in trying to treat the secondary symptoms only, such as the derangement of function of liver, stomach, &c., and yet, from what we saw in Mauritius, this latter method was pursued by not a few, who consequently must have ignored the sound pathology of the disease in spite of the lessons taught by the great physicians of India.

*Treatment.*—Beyond the use of diuretics and diaphoretics, *quina* was almost the only drug used, no leeches, no bleeding, no mercury, in fact the treatment so ably and energetically laid down by Deputy Inspector-General Maclean, of Netley Hospital, and most satisfactory was the issue, for out of a strength at Flat Island of 374·5 only four men died of the fever, and most certainly one of these four, if not another, would have been saved had he been treated with quinine, and this small mortality in spite of fatigue and hardships at Flat Island, and in spite of the supply of quina being at one time so small, that it was not given to any, except the most urgent cases. If the fever was "severe continued malarial fever," the quina was given at once without waiting for any remission, and given in good time. At the commencement of the epidemic, the dose of quinine was some 6 to 9 grains daily, afterwards 12 to 18, and finally in England it became necessary to give as much as 40 grains to stop the next accession of the ague fit; it was given as a rule in pills of 3 grains each, which had the advantage of being very portable, and, moreover, were better borne in cases with vomiting than the quinine in solution was. *Arsenic* was used rather extensively at Flat Island, but though undoubtedly useful, it could not for a moment be compared with quina, and owing to the amount of intestinal complication, it was found advisable to cease using it. As a rule an *emetic* was not given; even when a patient complained of nausea with a sense of weight at the epigastrium, and seeing that this sensation was due to the same agent which caused the headache and pain in the back and limbs, it is



difficult to see why the one should be treated and not the others, and this nausea, and even vomiting, generally ceased as soon as the hot stage had well set in. To prevent vomiting, for the most useful and successful remedy, was the *nitrate of bismuth* in 10-grain doses, various other remedies against the vomiting were tried but none succeeded so well as this one; a *purge* was seldom given, and certainly not as a matter of routine: our experience did not show that it was at all a necessary preliminary to "clear out the *primæ viæ*" before giving the quinine.

*Mercury* was not once used, except occasionally some calomel as a purge, and our results and experience satisfactorily show this drug is not at all required; even the liver may seem to be a little disordered, with tongue foul, yet we found that the quina, acting against the noxious causes of all the mischief, cleared the tongue, and set the liver all right, as well as put a stop to the next fit of ague. Comparing the mortality of the regiment with the immense mortality of the civil population, we think no greater proof could be given of rational and good treatment, though no doubt the attendance and good diet went a long way in Port Louis, to cause this difference; but it must be remembered that the deaths amongst those in easy circumstances, were far greater than amongst the soldiers.

We found the previously-observed fact to be the case in this epidemic, that if no quina were given for a fit of ague, the next fit came on at an earlier hour than the previous one, and that also the reverse was the case if quina were given. The *liq. quinoïdine* of Savory and Moore was tried in England, but by no means replaced quina as a preventative of the next fit of ague; moreover, it was very apt to cause vomiting. *Cinchonæ disulph.* was also used, but it required far larger doses than of quina to stop a paroxysm, and even then its action could not thoroughly be relied on.

#### *General Remarks on Points of Interest connected with the Fever.*

*Numbers of Non-Commissioned Officers and Men who escaped the Fever.*—Thirty-six, or 5·307 per cent. Two of the men had ague for the first time since, and some time after, their arrival in England, reducing these figures to 34, or 5·07 per cent.; of commissioned officers, 7, or 25 per cent., escaped; no marked characters as to strength of body or general health, to account at all for their escaping. *Yellowness of skin* was only marked in one case, and slightly in one other.

*Diuresis*, as a sequel to, or during the fever, occurred in one case only.

*The Fever not Contagious.*—It may seem strange that a fever whose general non-contagious character is so well known, should have been called contagious by any one; yet such was gravely set forth by a medical practitioner in the island, in a series of letters to a local journal. We are not aware, however, of any other practitioner in Mauritius holding like opinions—two perfect proofs of its being non-contagious were fortunately afforded in the regiment, viz.:—

1st. At Flat Island none of the whites and blacks there resident contracted the fever during the six weeks that the regiment was there stationed, though they mixed much with the regiment, of course excepting those who had visited Mauritius during the time of the epidemic; and,

2nd. No sailor on board the "Himalaya" had an attack of the fever during our passage home.

These are ample proofs of the utterly non-contagious character of the fever.

*Period of Incubation.*—The length of time during which the malaria may lie latent in the system without manifesting itself by fever seems to depend in very many cases on external conditions; thus most of the men and officers composing the head-quarters of the regiment had had no fever till after their arrival at Flat Island, and then, from exposure to sun and great fatigue, numbers of them were struck down soon after with fever; indeed, far more were attacked with fever in a short time than had been the case in Port Louis itself, where the amount of duty and work was very slight. That the period of incubation may be long is seen in the case of two of the 36 men who escaped the fever; these two men have had each a thorough attack of intermittent fever



during the cold weather in England ; in one about five months after leaving Mauritius, and the other six months after.

*Causes of Relapses of Fever.*—We have just seen that on the arrival of headquarters at Flat Island, that a large number of men who had been exposed to malaria in Port Louis were at once struck down with fever, and comparing the differences in their manner of life at the two places (and remembering that there was *no malaria in Flat Island*) we are literally bound to the conclusion that while they had very little work and no exposure to sun, &c., at Port Louis, though in a malarious place, they had been able to resist its effects ; but that the exposure to sun and great fatigues and other lowering conditions which they encountered at Flat Island, had the effect of bringing out the fever. We have also seen that, in England, the condition which brought on a fresh attack of fever was a sudden fall of temperature ; hence it would seem that any conditions which for the time lower the system, or reduce, so to say, its vital power, have a tendency to bring on a relapse of the fever. Perhaps these observed facts may help to explain the discrepancies which exist as to the height to which malarial poison may be carried, for it would be quite possible for a body of men to be exposed in a low-lying country to malaria, and yet on arrival at higher level and cooler atmosphere to be attacked far more generally with malaria than they had been in the lower level. These facts also unfortunately render it very difficult to determine whether malaria has ceased to be evolved in any place, thus, shortly before our embarkation from Port Louis, several undoubted fresh cases of fever occurred in people who had not had the fever ; but this was no proof that malaria existed still, for the weather had become markedly cool after having been very hot, and individuals who had passed untouched through the fever epidemic, when exposed to this great change of temperature showed symptoms of fever, just as relapses occurred in England, when there was a considerable fall of temperature, so that we are forced to the general conclusion that, given a person who has imbibed the malarial poison, his first attack of fever, or relapse after his first attack, may be (or generally is) brought on by some cause or causes which reduce his general vital energy, or causes which produce a certain lowering effect, or small shock to his nervous system.

*Causes of the large Proportion of Deaths among the Civil Population.*—We believe that we have shown that all people alike were attacked by the same disease, and that we must look for the excessive civil mortality to some other cause than the virulence of the disease itself ; and there can be little doubt that it was due to the want of proper attendance, and, above all, to the want of quinine. A very large number of those found dead in their huts or in the streets and fields, or were found and brought in in a dying state, were suffering from what we have named "malaria collapse," *i.e.*, they were people who had been thoroughly saturated with malaria, and had had no treatment, besides being in want of the common necessities of life. This is a most important point in every way, for in future epidemics with a good store of quinine in the island, and a regular system of relief, a comparatively small death-rate will result, it being a very different case from an epidemic of cholera or yellow fever, over which we have no curative remedies ; *i.e.*, it is only in this way that we can account for the enormously disproportionate number of deaths in the civil and military population, unless we revert to the out-of-the-way theory that the same poison acted differently on the military and civilians. In a letter from Dr. Charsley, the Principal Civil Medical Officer of Ceylon, he stated that on being applied to by Government on the question of putting vessels from Mauritius into quarantine, as the result of his examinations of the crews of vessels from Mauritius, he found all the cases were "neglected intermittent, drifting into the remittent, low, typhoid type," and, consequently, that no quarantine was necessary. This opinion of a gentleman thoroughly well versed on all the forms of malarial disease perfectly tallies with our own, *viz.*, that the fatality of the disease was not due to its inherent, dangerous nature, but the want of proper medicine and attendance. We may safely predict that with a good stock of quina no such fatal epidemic can again occur, provided that the quinine is given freely and without fear ; for we heard in Mauritius of such bugbears given out, and that, too, by medical men, that quina in large doses caused dysentery and other internal complications ; and



one gentleman asserted, in the face of the fearful mortality amongst his own patients, that a few grains of quinine were quite sufficient, without resorting to large doses.

*Existence of Malarial Fever prior to 1866-67.*—This is a somewhat difficult point to settle, as what is called "Bombay fever" in Mauritius (a bilious remittent fever) occurs almost entirely amongst a people who had been subject to malaria in their native land, and consequently relapses occurring amongst them might be due to mere effects of fall of temperature and the like. It is, however, certain that occasionally a few cases of genuine intermittent fever occurred in past years in the hot season, but to a very inconsiderable extent, at the same time, from the general non-recognition of true "enteric fever," numbers of this fever were put down as "Bombay fever" or "continued fever," and seeing the mode of life in Indian settlements in Mauritius, it would afford most excellent opportunities for a spread of "enteric fever."

*Influence of Elevation in relation to Malarial Fever.*—The well known fact that elevation gives a certain amount of immunity from or lessens the danger of the influence of malaria was well shown in the detachment 2nd Battalion 22nd Regiment, stationed on the small height in Port Louis, called the Citadel, or Fort Adelaide, and though the barracks here are casemates, and very close and badly ventilated, yet the men resisted the malarial influence for nearly two months, during which time the fever was raging in the town itself, and amongst the troops in the Line Barracks. In this case, the fact of their spending the night high above the level ground seems to have preserved them for long from the malaria, and this accords with the general experience that it is at night or in the early morning that men are most liable to be attacked by fevers and the like, and this seems to tally with the fact that on first rising in the morning in hot climates the temperature of the human body is at its lowest point (we have found in Mauritius by experiments on ourselves, the truth of this fact observed by Dr. John Davy, in the West Indies), consequently we can well understand that at this time the body has less resisting power against malarial or any other poison.

*After Effects of the Fever, i.e., other diseases than mere relapses, which could in any way be attributed to the results of the malarial fever.*

*Phthisis Pulmonalis.*—One case of this disease occurring after the fever, died on passage home, and second was discharged the service for chronic hepatitis, who died at the Military Hospital, Portsmouth, and *post-mortem* was found, besides a very large liver, tubercles scattered throughout both lungs.

A third case of phthisis pulmonalis, after fever and dysentery, was discharged the service at home, the disease having come on after malarial fever and dysentery.

A fourth case, with hepatitis, discharged the service at home.

These are all the cases of phthisis which occurred in the regiment in men who had not the disease before the outbreak of fever.

*Hepatitis, 1st.*—The case above mentioned who had tubercle of lungs.

*Hepatitis, 2nd.*—Of a man who had tubercle of lungs, as well as hepatitis, discharged the service at home for chronic hepatitis, probably a form of cirrhosis, being a great drunkard.

No cases have occurred which could be attributed to the effects of the fever.

*Asthenia.*—Case already mentioned of a man who died on board ship, on passage home. Unfortunately no *post-mortem* could be made, and his symptoms were very obscure.

*Kidney Disease, 1st.*—One case has already been given (Private Hawkins), who died in Flat Island. Probably he had had chronic Bright's disease, for some time before, and the fever was not the cause of the disease, though it hastened his end.

*2nd.*—A case of a serjeant, who died on 23rd November, 1867, of double pleurisy and kidney disease, at Weymouth. He had repeated attacks of ague, more so perhaps than any other man, but he generally convalesced from them very rapidly. The *post-mortem* signs were—Body with much fat under skin (as in the case of Private Hawkins, given before), both lungs universally and firmly adherent, and full of frothy fluid; liver very tough and hard; spleen nearly natural in size; right kidney very pale and mottled, internally, so much so that it was quite white in parts, the whole of pale colour; and the distinction between



the pyramids lost ; under microscope, chiefly inflammatory products seen, *i.e.* cells of various shapes and granules, with some fatty degeneration ; left kidney completely converted into a series of seven or eight cysts, containing white creamy matter ; no pus.

It would be dangerous to attempt to found any decided inference as to cause and effect of malarial fever in kidney disease on these two cases only, and as no other cases have been seen amongst the men, it would seem to be probably accidental.

In conclusion, we would say that except phthisis pulmonalis no disease as yet has been seen by us amongst the men whose origin we could attribute to malaria.

*Relapses of Fever amongst the Officers.*—Four of the officers have left the battalion, of these three had the fever ; two others have been on sick leave all the time, consequently no certain data of the relapses of fever can be given amongst the officers ; suffice it to say that all except one have had relapses since their arrival at home ; none of those who escaped the fever abroad have had attacks at home.

*On the Fever as it occurred amongst the Women and Children.*—No woman or child escaped the fever, the children especially had relapses after relapses, and though so many died at Flat Island, it was astonishing that more did not perish.

*Women.*—Deaths two. (1). One woman died at Flat Island of dysentery, a chronic case. (2). One died at home, a few days after landing, of dysentery, having had many attacks of fever.

*Children.*—20 died in all. One in January, 1867, at Port Louis, of dysentery ; one in February, 1867, at Port Louis of dysentery ; one in March, 1867, of feb. malaria at Port Louis ; thirteen at Flat Island, from 1st April to 23rd May, 1867, of dysentery or fever, or both, but chiefly from want of proper nourishment ; one in Port Louis of chronic dysentery on 31st May, 1867 ; two on passage home in June, 1867, of fever and dysentery ; one in England in July from asthenia after fever and dysentery.

From this statement it will be seen that up to 31st March, 1867, though fever was killing thousands of civilians, only one baby died of it, and that it was only at Flat Island, and shortly after, that any serious loss occurred, which was easily explained by the want of milk, eggs, good bread, and the like. The strength of women and children when the regiment went to Flat Island was 40 women, of whom one died at Flat Island, and one at home ; 70 children, of whom 16 died at Flat Island, or soon after, and one died at home.

*On the use of Sulphur and Hyposulphite of Soda in Malarial Fever.*—In pursuance of an Order, dated 24th October, 1867, from the Director-General, Army Medical Department, a certain number of men were placed under this sulphur treatment, viz. :—

1. Corporal M. Serriner, age 30, in hospital with gonorrhœa and suppurating bubo.

November 3rd. Fit of ague.

4th. Take soda hyposulph., grains 30, at 9 A.M. and 12 A.M.

5th. No fever yesterday. Take soda hyposulph., grains 30, *ter in dies*.

6th. Ague fit yesterday. Continue soda hyposulph., *ter in dies*.

7th. Fever yesterday. Continue soda hyposulph.

8th. Ague fit this morning. As the last attack was very severe, and the man was pulled down, the soda hyposulph. was stopped, and he was put on full doses of quina, which stopped the relapse. In this case the hyposulph. of soda was quite useless.

*Case 2.*—Boy Troupe, age 17. This boy had had very many attacks of ague.

October 21st. An ague attack. Treated for two days by quinine, and after ferri et quina citrat.

27th. Put on 30 grains of sulphur three times a-day, and took it continuously till 28th November, when he had an attack of ague. Took quina, grains 36.

29th. Take quina, grains 12.

30. Put on soda hyposulph., grains 25, *ter in dies*, and took it 27th December 1867.



January 1st, 1868. Had relapse of ague. Treated with quina, as it was evident that the sulphur and soda hyposulph. did not stop the attacks.

Case 3.—Boy Isaiah Webb, age 15.

November 19th. Had ague fit.

20th. Quina, grains 38.

21st. Ferri et quina cit.

27th. Sulphur, grains 30, *ter in dies*, and took this for a month.

December 24th. Had an ague fit in spite of all the sulphur he had taken.

Case 4.—Private A. Mathews, age 28.

October 27, 1867. Has had four relapses of ague, the present one being fourth. Take sulphur, grains 30, *ter in dies*.

28th. Fever again this morning. Continue sulphur.

29th. Fever again this morning. Sulphur this morning, but as he is getting weak and feeble, is put on quina—viz., grains 18, at 2 P.M. and 8 P.M.

30th. No fever. Quina, grains 6, at 10 and 12 A.M.

November 1st. No fever. Continue sulphur.

6th. Has been taking sulphur three times a-day; discharged well.

Case 5.—Private J. Cusack, age 17.

November 6th, 1867. Attack of ague. Take soda hyposulph., grains 30, *ter in dies*.

9th. Has had ague each day, and last attack very severe. Omit hyposulph. soda. Take quina, grains 18, at 2 P.M., and hyposulph. soda.

10th. No fever. Quina, grains 3, *ter in dies*.

11th. No fever. Quina, grains 3.

Case 6.—Private Parker.

November 9th, 1867. Attack of ague. Take soda hyposulph., grains 60, *ter in dies*.

10th. No fever. Soda hyposulph., grains 60, four times a-day.

11th. Took one 60-grain dose of soda hyposulph., and soon after a fit of ague came on.

12th. Quina, grains 18, at 9 A.M. and 12 A.M.

13th. No fever. Quina, grains 18.

14th. No fever. Quina, grains 12.

Here, again, the use of these medicines seems to have been of no value in preventing or stopping the ague fit. Accompanying the document from the Army Medical Department, was an extract from the "Commercial Gazette of Mauritius," in which Dr. Schmidt gave his opinion on the use of sulphur and the hyposulphites, acting on a suggestion of Deputy Inspector-General F. Reid, this paper went to prove that the fever was cured, and relapses prevented by the use of these medicines. It also went so far as to explain their action in the prevention and cure of malarial disease, and finally ended with an account of the action of quina, which, according to the author, acted only by its astringent or "withering" qualities. As a matter of fact we examined several simple unicellular plants, similar to those which Dr. Schmidt found on and in all the bodies of patients suffering from malarial fever, and exposed them under the microscope to the action of a strong solution of hyposulphite of soda, but no perceptible result followed. It is to be regretted that Dr. Schmidt did not adopt this simple plan of testing the powers of the drug on the low vegetations which he describes as occurring only in people suffering from malarial fever. This gentleman's hypothetical description of the action of quinine in curing malaria was of a very simple description, but as it went to show that quina acts by a process of astringency, which he takes as synonymous with withering, we may with good reason have been sceptical as to the value of sulphur and its compounds; and in the few cases in which we employed it, our scepticism was amply borne out. It was so evident, that having made up his mind on the hypothetical action of sulphur and its compounds on these unicellular plants, that Dr. Schmidt tried to twist the action of quinine into a similar process, but it is quite certain that no process of withering, and so destroying the parasite plants, can explain its action, especially in those cases of "malarial collapse." From its influence in these cases, and the diminishing the size of the spleen, it is evident that the main action of quina is on the blood. To call quina simply an antiperiodic is no explanation of its action, and that it is an absolute cure for malarial disease is again not exactly the



case, for it stops the "continued" form of malarial fever, just as well as the "intermittent" or "remittent" form but only for a time; but whether it acts directly on the blood, or on the nerve elements of the blood vessels, is uncertain; but undoubtedly its action is on the circulation of the blood in some way or other.

## V. ADDENDUM.

*The Dysentery.*—Before referring more especially to the peculiar form of dysentery, which attacked the regiment at Flat Island, a few remarks on the ordinary acute dysentery of Mauritius are given as preface.

*Causation.*—Whatever may be the predisposing causes of dysentery, the exciting cause is always a sudden change from warm to cold weather, especially if with rain and high winds; and as a rule in Mauritius the dysentery occurred in small epidemics, there always being a certain number of men attacked about the same time; towards the end of the hot season when the S.E. winds begin with rainy chilly weather, dysentery prevails. As to predisposing causes, whatever tends to bring the health below par, undoubtedly also conduces to liability of being attacked by dysentery, hence the number of predisposing causes must be numerous: in the annual report of 1866, this subject is referred to, and the almost total absence of cases of dysentery amongst the officers, was stated as probably due to their better feeding, or, in other words, that the diet of the men was not sufficient, and consequently a below par state of health prevailed among them.

The symptoms of the ordinary dysentery of Mauritius are much the same as usually described; the treatment is very satisfactory by large doses of ipecacuanha.

### *The Dysentery at Flat Island.*

*Symptoms.*—Briefly to characterise this form, the stools were simply of thin, smoky, dark fluid (of disintegrated blood and water); no sloughs (until some time after commencement of the disease, and not necessarily then), with no trace of feculent, nor indeed of any solid matter; great depression of patient's powers, and tendency to coldness of body, but mind quite clear; after death the signs were total sloughing of whole of internal coats of large intestine, or merely a prominent state of all the glands; there were some cases at the time of the ordinary dysentery, with its mucous slimy stools and ulcers of the large intestine.

The first case occurred on 23rd April, when the end of the hot season was marked by strong cool S.E. gales, with occasional showers of rain, a great change after the hot sultry weather which had prevailed for so long, and a very large number of men began to be attacked by bowel complaint (a certain number of the cases will be given hereafter). The first fatal case terminated in 6 days; ipecacuanha was of no avail, it caused excessive vomiting, and so our main, nay, almost sole weapon was useless; after making the *post-mortem* of this case, the idea came (how or why, one cannot say) of using *very large doses of tinct. ferri perchlor.*; this was adopted, and succeeded admirably.

*Pathology.*—As in the case of the fever, we give a series of cases first.

*Case 1.*—Private James Wilson, age 29, service eight years.

*Symptoms.*—From 9th April to 13th April treated out of hospital for an attack of malarial fever, but admitted, as he did not improve; on 22nd April was seized with profuse dysenteric diarrhœa, stools being merely dark fluid, not a particle of feculent matter and no sloughs; it resisted all treatment, including ipecac.; he died with body quite cold, but mind clear, on 29th April.

*Sectio cadaveris*, 19 hours *post-mortem*.

*Body*, very much emaciated and shrivelled.

*Liver*, healthy; on upper surface of right lobe a deep linear scar (no history of syphilis).

*Lungs*, healthy, but little congestion even at bases.

*Heart*, blood on both sides; no clots.

*Kidneys and brain*, healthy.



*Spleen*, a little larger than natural.

*Small intestines*, healthy.

*Omentum*, attached on left side to brim of pelvis, on right side by its edge to side of abdominal wall.

*Large intestine*, adhesions to liver, spleen, kidneys, psoas muscles, and wall of abdomen, and on detaching it, gut gave way; along whole canal, lying in centre, a thick soddened slough of internal and middle coats, external intestinal coats being left quite clean, and gut looked very thin; this slough extends from ileo-cæcal valve to anus, the smell only rather offensive; slough in squeezing yielded a quantity of dirty-water like fluid.

*Case 2.*—Private F. Arnold, age 27, service 8 years.

*Symptoms.*—A strong, healthy young man, who had not had the slightest signs of fever or malarial disease, on 9th May attacked with same sort of dysentery as last case, with passage of great quantities of dark, thin non-feculent fluid, died 15th May, with all the symptoms same as last case; features became pinched, and voice very husky.

Took ipecac., sulphuric acid and tinct. ferri perchlor. (but not in very large doses).

*Section cadaveris.*—Right side of heart and veins full of dark-coloured fluid blood, and in left ventricle a firm white clot.

*Lungs*, a little congestion at very bases.

*Spleen*, rather smaller than usual.

*Brain*, healthy, but good deal of blood in veins.

*Liver*, healthy, but sinuses full of blood.

*Kidneys*, healthy.

*Small intestines*, quite healthy, contained a small quantity of stuff like finely-chopped spinach.

*Large intestine* (beginning sharply at ileo-cæcal valve), thickened throughout, not thinned anywhere, no ulcers, but patches of dark-coloured, rather soft material (stained by iron he took), mucous coat had almost disappeared, and muscular coat was softened and exposed.

*Omentum and intestines*, externally looked rather rosy red, about one pint of thin blood-stained fluid in peritoneal cavity, no lymph, &c.

*Case 3.*—Private P. Mountjoy, age 27, service 8 years.

*Symptoms.*—Admitted 3rd May, for attack of malarial fever, convalesced well, but on 16th May, while in hospital, seized with passage of an enormous amount of thin fluid stools, and on the 19th vomiting, as well as purging; he died suddenly on 20th May, features being very pinched and body very cold, but at time of death, and for some hours after death, body got warmer; the vomit and stools were like rice-water, but stools were dark at first.

*Section cadaveris*, 24 hours post-mortem.

*Brain*, not examined.

*Heart*, rather large, gelatinous white fibrin clot on left ventricle: the same, but not so large nor loose, and darker-coloured, in right ventricle.

*Gall bladder*, full of thin bile.

*Large intestine*, no very evident lesion, beyond softening of internal coat and all glands very prominent and distended, the gut quite pale.

*Small intestine*, very pale, glands all enlarged, which made it, especially the upper part, look rough, from prominence of glands; both it and large intestine full of milky white, thin fluid, with fine flocculi floating in it; no appearance of bile in intestines.

*Mesenteric glands*, somewhat enlarged.

*Lungs, liver, and kidneys*, no naked eye lesions, and no noticeable congestion.

*Spleen*, about one-quarter too large.

*Case 4.*—Private George Alwin, age 27, service 8 years.

*Symptoms.*—In hospital, and convalescent from malarial fever, on 30th April profuse stools, with straining of dark, watery fluid; acid sulphuric given 1st May. Tinct. ferri perchlor., 120 m. to be taken to-day.

*May 2.*—Stools nearly well; took 60 m. tinct. ferri perchlor.

*May 3.*—Well; ferri et quinæ cit., *ter in dies*.

*May 11.*—Discharged well.

*Case 5.*—Private James Glover, age 26, service 8 years.



*Symptoms.*—While in hospital for malarial fever was attacked, 19th April, with dysentery, with profuse stools of blood and water. At first used large doses of ipecac., &c., but no use.

*May 1 and 2.*—Took 120 m. of tinct. ferri perchlor., and on

*May 3 to 6.*—180 m. per day.

*May 7.*—300 m. per day.

*May 30.*—Acid and quassia.

*June 5.*—Well.

The good effect of iron was seen in passage after a few days of tubular sloughs, some of them 3 inches long; he was in the most dangerous state, but recovered well; ipecac. could not be borne.

*Case 6.*—Private Edward Baxter, age 27, service 8 years.

*Symptoms.*—Convalescent in hospital from malarial fever; on 7th May was attacked with most profuse passage of stools of thin, dark fluid; this lasted for several days, and he was reduced to a most deplorable state of emaciation and debility. He was treated with large doses of tinct. ferri perchlor., and recovered well, being discharged on June 12th.

*Case 7.*—Private William Wilks, age 32, service 8 years.

*Symptoms.*—Nearly as severe a case as the last; was treated in same way, and recovered well.

*Case 8.*—Boy, A. Troupe, age 17, service 3 years.

*Symptoms.*—The same passage of thin blood-stained non-feculent stools; treated with tinct. ferri perchlor., 200 to 300 m. per day. This boy has had very many relapses of fever since, but no more dysentery.

*Case 9.*—Boy, J. Cusack, age 17, service 2 years.

*Symptoms.*—Precisely same symptoms and treatment as last; and though he has had very many relapses of fever since, has had no other attack of dysentery.

*Case 10.*—Boy, William Campbell, age 17, service 2 years.

A most severe attack of same sort of dysentery, and same treatment; recovered very well.

*Case 11.*—Private Robert Grabby, age 28, service 8 years.

A most dangerous and severe attack, with same symptoms; but passed, after taking the iron, a large number of tubular sloughs; recovered well.

The above eleven cases were of the peculiar dysentery which attacked the regiment at Flat Island, characterised by passage of enormous quantities of thin blood-stained fluid.

The following cases were the fatal ones of ordinary dysentery which occurred during the fever time, viz. :—

*Case 1 A.*—Private Patrick M'Namara, seized with dysentery of ordinary type, and malarial fever; refused obstinately to take any medicine, and died on the night-stool.

*Sectio cadaveris*, 8 hours *post-mortem*.

All organs healthy, but

(1.) *Spleen* pulpy; about  $\times 3$ .

(2.) *Large intestine* full of ulcers, with ragged edges and foul sloughs, and coats good deal thickened.

*Case 2 A.*—Private Thomas Jones, had had several attacks of dysentery from October 1866; had several mild attacks of ague, and got fearfully reduced at Flat Island; died 24th April, 1867; the symptoms being of the ordinary dysentery.

*Sectio cadaveris*, 6½ hours *post-mortem*.

*Large intestine* in universally sloughy and ulcerated state, but more especially at rectum, which was attached to anterior wall of abdomen, in middle line above the bladder; here was a small perforation partly filled up and protected by recent soft lymph, some of which lay amongst intestines in the neighbourhood. In some parts, especially of ascending colon, gut so thinned that outer coat formed a series of small protrusions or hernias, thoroughly thickened parts of coat.

*Spleen*, natural in size. All other organs healthy.

The last two cases, viz. 1 A and 2 A, were of the ordinary dysentery, both in symptoms and pathology, and require here no further remarks. The eleven previous cases give all the fatal cases, with a selection of eight recoveries out



of a larger number which occurred at Flat Island. Case 3 looks like a case of cholera, but his *first* stools were the same dark colour as the rest of the cases.

Case 2 showed very little *post-mortem* lesion, but the stools were not at all, at any stage, rice-water like Case 1, which was a very marked case. Of the other cases, very many were as severe as the fatal ones. This form of dysentery looks very much like that called in books "*scorbutic dysentery*." The two stages of the lesion seems to be general prominence and distension of all the intestinal glands; and if carried further, instead of each forming an ulcer, a general death of the two internal intestinal coats ensue, and they are thrown off as sloughs. This was very marked in Case 1; and in several of the cases which recovered, large portions of the intestinal tracts were thrown off as sloughs, though in most the disease was arrested before this stage of sloughing came on. Some fifty cases in all of this form of dysentery occurred, but in a good many it was so soon arrested by the tinct. ferri perchlor. that they were not admitted into hospital. A large proportion occurred in men who were in hospital at the time. Two cases of dysentery were left behind, and died at Flat Island, but unfortunately no details of the *post-mortem* appearances reached us.

*Causation of this Form of Dysentery.*—At first blush that convenient scape-goat malaria might seem to have been the exciting agent of this dangerous and rapidly fatal form of dysentery; but this cannot be the case, for the following two reasons:—(1.) Of the three men who died of it, one never had fever at all, while *post-mortem* no enlarged spleen or other sign of fever was found; and the other two had not suffered remarkably from fever. (2.) While this form of dysentery was confined to Flat Island, where, as we have shown, malaria was not present, at Port Louis, the centre of the malarious district, no such cases of dysentery occurred; and indeed only three cases of dysentery in all occurred there from 1st April to 24th May, and those three at about the same time in the week ending May 24, and they were cases of the ordinary dysentery. At Cannoniers' Point, from the 16th February to the 31st May, only seven cases of dysentery occurred; and none of these presented any variation from the usual dysentery of Mauritius, and were far less in amount than at Flat Island: thus the amount of influence the malaria had in causing this variety of dysentery was no more than that of any other disease tending to bring down the health below par. To what, then, can we attribute this disease? We believe solely to the effects of exposure, in a hot sun, of men who were enfeebled by the effects of malaria, together with poor food, and especially the want of such bland food as milk, good vegetables, and bread; for in these Flat Island was wanting, while they were procurable both at Cannoniers' Point and Port Louis. This is borne out by the fact that in the character of the stools there was a close resemblance to the form of dysentery called *scorbutic*, which is owing to improper, or want of certain articles of diet—in our case this want not being carried to such an extent as to cause any general signs of scurvy. At the same time lime-juice had been issued to all as a precaution, but was found to add to the intestinal irritation, and was therefore discontinued. Again, in connection with the supposed intimate relation between malaria and dysentery, which has been assumed so often, we find that out of a regiment in which 671 men were attacked by fever, 102, or 15·2 per cent., had dysentery during the fever epoch, and that of these 16 had had one or more attacks of dysentery before the fever broke out; and that there were 52 men who had had dysentery before the fever broke out, and some of them had been almost chronic cases, and these 52 men had no dysentery during the epidemic of fever. Again, dividing those who suffered from dysentery into four classes, as regards the severity of fever from which they suffered, we find—

1. 1 man who *died* of dysentery had had *no* fever.
2. 36 men had dysentery, who suffered only *slightly* from fever.
3. 52   "               "               "               *severely* from fever.
4. 13   "               "               "               *very severely* from fever.

Summing up all these points it would seem that, as regards the epidemic of malarial fever in Mauritius, certainly the malaria had no influence on the causation of dysentery more than any other weakening disease; and as far as we have been able to learn, dysentery has not been more frequent in Mauritius



since the epidemic. Whether this holds good elsewhere we forbear to say, but in Mauritius, it would seem certain that there is no such thing as malarious dysentery, and that the presence of dysentery in malarious countries is a mere coincidence, and not cause and effect. Further, we found that giving quinine in these cases was followed by no advantages, and indeed seeing that one of our first cases of this form of dysentery occurred in a man who had never had any fever, we were not much encouraged in the supposition that it was of malarious origin.

*Treatment.*—I have already incidentally noticed this. Ipecac. in large doses, usually so successful, was quite useless; calomel, in 10 gr. doses, served no better; sulphuric acid and opium were equally unavailing; quinine gave us no assistance, *but the tinct. ferri perchlor. in doses amounting from 200 to 400 ms. per day, succeeded most admirably*; we have seldom, except in the cases of quinæ in malarial fever, and ipecac. in ordinary dysentery, seen a drug which effected so much, and to such purpose, as this salt of iron did in these really terrible cases of dysentery, though of course further experience is required to make sure of its value elsewhere.

## APPENDIX II.

Prevalence of "enteric" (typhoid) fever during the epidemic of malarial fever.

From July 13th, 1866, to March 31st, 1867, during which time the regiment was stationed in Port Louis, 10 cases of enteric fever occurred among the non-commissioned officers and men, of which four were fatal.

Amongst the commissioned officers, one case occurred, who recovered giving a total of eleven cases, with four deaths, *i.e.*, 36·36 per cent. were fatal.

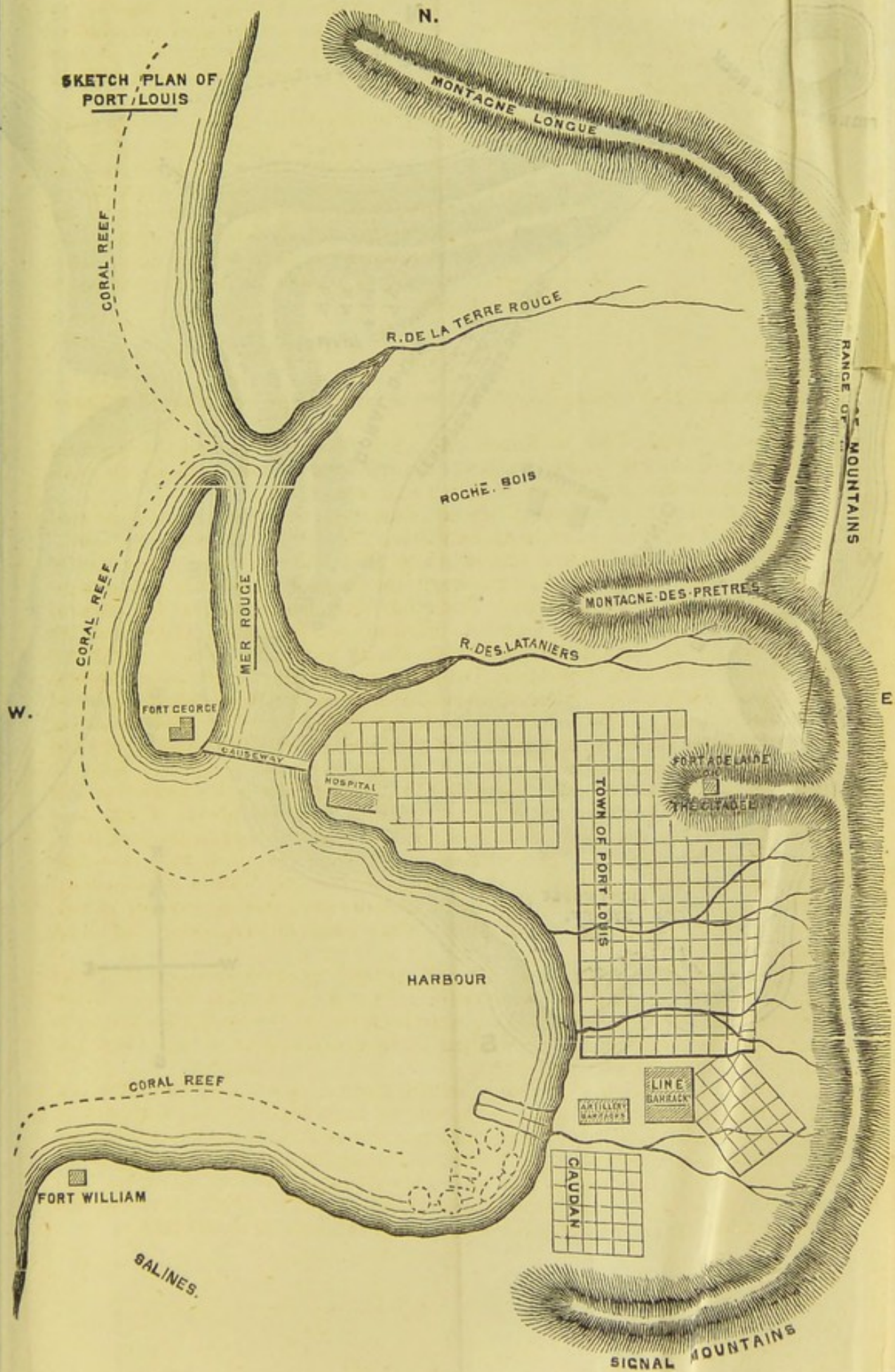
Of the fatal cases, the first was struck down in the very onset of the disease and died on the fifth or sixth day, though the diagnosis, and even *post-mortem* appearances were rather obscure. The other three had a most severe form of the disease, in which the diseased intestine, at ileo-coecal valve, was so prominent as to form a distinct large elastic tumour; one of the three convalesced well from the fever, but died shortly after from psoas abscess undetected during life. None of these cases were complicated with malarial fever, but the commissioned officer (a young Ensign) had several attacks of "malarial fever," the fever was in his case very severe, but fortunately not complicated by hæmorrhage, &c. A certain amount of enteric fever is generally found amongst the troops in Port Louis in the hot season, but this season there were a greater number. Seeing the condition of drainage matters in Port Louis, such might well be the case and though unrecognised, there were probably very many cases of "enteric fever" during the late epidemic, and the peculiar and dirty habits of the inhabitants afford a most excellent opportunity for the spread of this disease; but apparently it has, as a rule, been called by some other name, and has not been distinctly diagnosed.

The cases we have given were all, but perhaps one, undoubted cases of true "Enteric fever," as proved by the general symptoms and range of temperature and in cases of death by *post-mortem* examination; in the fatal cases the form was very severe, indeed the prostration being great and very early, and the extent of intestinal lesion very great.

*Conclusion.*—We trust that we have now given an account of the fever and its accompanying diseases, sufficient to convey some decided impressions of its origin, cause, and fatality. There are many errors and imperfections, but we may plead the excessive amount of work thrown on us as some excuse for shortcomings, for, as generally is the case when these epidemics occur, the few medical men present have more than enough to do in merely treating the sick, and have no time for making a very close research or examination.

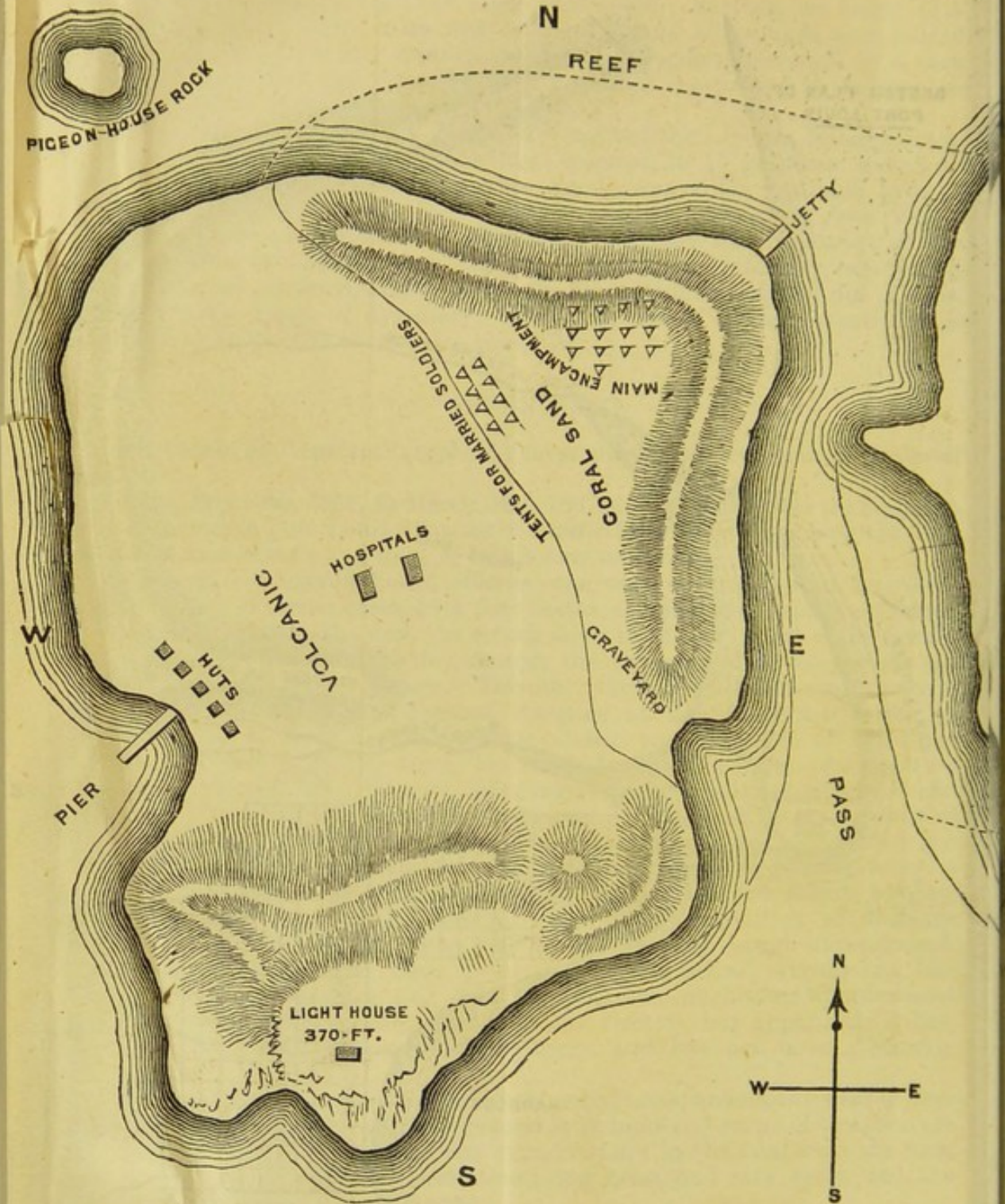


## PLAN OF PORT LOUIS.





## PLAN OF FLAT ISLAND.









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