

Observations on the means of preserving the health of troops, by selecting healthy localities for their cantonments / by Edward Balfour ; read by Joseph Hume ... before the Statistical Society of London, on the 19th of May 1845.

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OBSERVATIONS

ON THE

MEANS OF PRESERVING THE HEALTH OF TROOPS,

BY SELECTING

HEALTHY LOCALITIES FOR THEIR CANTONMENTS.

By Assistant Surgeon EDWARD BALFOUR, Madras Army.

Read by JOSEPH HUME, Esq., M.P., before the Statistical Society of London, on the 19th of May 1845.

THE frequent occurrence and the severity of the diseases of tropical countries had long made us aware of the differences existing in the salubrity of neighbouring localities. "It is now ascertained, that even in our own country there is a very material difference in the degree of health and longevity attained by the rural inhabitants of some counties compared with others; for instance, those resident in North and South Wales, Cornwall and Devon, Northumberland and Cumberland, are not so liable to mortality, by at least a tenth part, as those in the central counties of the kingdom. The same remark also applies to the Highlands of Scotland; and it appears that the troops in the latter country have been rather more healthy than in England or Ireland."* But in most of our colonies, where the agent that excites disease acts with greater intensity, these differences are more strongly marked, every island, and almost every province, within the tropics, furnishing us with instances of disease and death occurring with great frequency in one place, while in another, only a few miles distant, the mortality may scarcely exceed what the troops would be subject to in their native land; and our knowledge of this fact, though acquired only by experience, and at a great loss of men and money, points out to us one means of preserving the lives of our men. It is true that political reasons may often render it necessary to retain our soldiers in very unhealthy districts, and we shall then be called upon to employ all our skill to protect their health. But where these state necessities are not very urgent, it will often be possible to locate men where they will be free from sickness, within a few hours' march of the unhealthy district over which they are required to watch. During times of trouble and disorder, much, as regards health, must remain subordinate to the safety of the force, and the security of the district or country in which it is placed; but the profound quiet throughout our Eastern dominions is a sufficient proof that there are, at least, no such urgent demands upon our European troops there as should compel us to sacrifice their health; for this part of the army, though ready at all times to take the field at an hour's warning, have

* Reports on the Sickness, Mortality, and Invaliding of the British Army.

for more than a quarter of a century been employed only in distant expeditions against a foreign enemy, marching for months before they reached the scene of war. With such long marches before them, it must be of immaterial consequence from what position in a remote province the troops first break ground; a few miles to the right, or left, or rear, would not retard for a day their junction with the brigade with which they were destined to co-operate.* It is true that the chief authorities of the Government can alone possess that knowledge of the state of the people requisite to decide on the districts requiring the presence of troops, and with them the distribution of an army must ultimately rest; but it must be at all times useful to know the localities where a force may be placed with the certainty of their suffering the least possible loss from sickness and death. This subject has often before been noticed; but from various causes, perhaps from the limited number of facts that could be brought to bear on it, it has not hitherto attracted the attention it deserves. The reports published on the health of troops in the British colonies, enable us, however, to give numerous instances of great differences in the degree of health enjoyed in stations only a few miles apart; and, considering its importance, whether as a means of reducing the heavy sick lists, of lessening the number who every year die, of effecting a great saving to Government, and placing in their hands a greater amount of disposable force, it may not be deemed needless to enter somewhat at length into the details of those colonies, where the differences in the degree of health are most marked.

The forces serving in the Windward and Leeward command, from 1817 to 1836, averaged 4,333 strong. During that period, 7,069 men died, and the average annual mortality was 85 per 1,000 of mean strength. But the following table of the rates of mortality in the different islands will show that it is possible to distribute the troops in such a manner as to diminish this number of deaths:

	Annual Ratio per 1,000 of mean Strength died.	Average Strength.
Antigua and Montserrat - - - - -	40·6	403
St. Vincent's - - - - -	54·9	372
Barbadoes - - - - -	58·5	1,197
Grenada - - - - -	61·8	313
St. Kitts, Nevis and Tortola - - - - -	71·	290
British Guiana - - - - -	84·	884
Trinidad - - - - -	106·3	310
St. Lucia - - - - -	122·8	241
Dominica - - - - -	137·4	236
Tobago - - - - -	152·8	170

The island of Dominica lies detached from the others, being more than 100 miles north of St. Lucia, and it might be imprudent to weaken the force

* European troops could never be employed as the police of a district, the duties of which must be performed by the less expensive part of the Indian Army—the native soldiers. The latter, indeed, are, to a great extent, employed in duties which might be as well done by undisciplined men; and though such employment tends greatly to injure discipline, it is, nevertheless, almost indispensable, in order to diminish the heavy expense of so large an army.

there ; but the same objection does not apply to some of the others that are nearer each other.

* _____	Ratio of Deaths per 1,000 annually.	Average Strength.
Antigua and Montserrat, 1817 to 1836 - -	40·6	403
St. Kitts and Nevis, only 50 miles North West of Antigua - - - - -	71·0	293
St. Vincent's - - - - -	54·9	372
St. Lucia, 40 miles North of St. Vincent's -	122·8	241
Grenada - - - - -	61·8	313
Trinidad - - - - -	106·3	310
Tobago, 6 miles East of Trinidad, and 60 miles South East of Grenada - - - - -	152·8	170

If the degree of health enjoyed by the troops regulated their distribution, the vicinity of Antigua to St. Kitts, with double the ratio of deaths, and of St. Vincent's to St. Lucia, and of Grenada to Tobago, with more than twice the rate of mortality, might be easily taken advantage of to station the head quarters in the islands where the troops enjoy the highest degree of health, retaining only small detachments in the sickly islands. It is doubtless a serious matter at any time to weaken a force too much ; and the risk from doing so is greater where there may be a difficulty of re-inforcing the troops on emergency. In such an island as the Mauritius, for instance, which is nearly two months' sail from any colony whence additional troops could be brought, to reduce the force might endanger its safety. But the Leeward Islands are all so contiguous that most of the unhealthy islands could receive support within a few hours after a re-inforcement was required ; and, indeed, with the aid of steam and other means of communicating intelligence rapidly, even the islands that are farthest apart might, on an emergency, obtain assistance in a day ; and this reasoning is still more applicable to the distribution of troops in a small island, or in the province of a continent where no obstacle exists to interrupt communication, or obstruct the advance of troops.

Within the last few years the Bombay Government have applied their knowledge of the differences that exist in the salubrity of adjoining districts to save the lives of their European troops. " On the island of Bombay and Colabah (a narrow slip jutting out from Bombay into the sea) the health of the Europeans was so unsatisfactory, and the mortality so high, that they determined to remove them from Bombay, and leave only a small detachment, sufficient to supply a few guards. And the head quarters of four of the European regiments belonging to the Bombay Presidency are now located at Poonah and Kirkee, where the average rate of mortality for the last 10 years has been 23·3 per 1,000 ; a ratio very small for India, and not much exceeding that of the Foot Guards in England."†

It is to the course adopted by the Bombay Government that we would

* It is not meant to be asserted, that the distribution in this Table is the best that could be adopted, or even practicable. The distribution, as was previously mentioned, must be left to the Government. The sole object is to make it manifest, that great differences as to health do exist in adjoining localities, and I think we are called upon, as well from motives of humanity as for the purpose of saving expense, to occupy those which we know to be healthy, and search for others that may be equally so.

† Letter from Superintending Surgeon Glen. Bombay Army. to Secretary to Madras Government.

particularly direct attention. If the European forces at Poona were required in the neighbourhood, the excellent roads and bridges, and other facilities for moving, bring the principal points in the districts within a few days' march; and, even Bombay, the seat of government, is only 80 miles distant, a journey which infantry might easily accomplish in 60 hours.

As our knowledge of the colonies of the empire increases, we may confidently hope that many healthy localities will be discovered, and occupied, as Poonah has been. But as this subject has been hitherto little attended to, some remarks may be made on a few of the sites which experience has proved to be well adapted for the residence of Europeans, as they serve to show how much we have it in our power to preserve the lives of men, and also to point out where healthy localities are likely to be met with. The principal portion of the European or native forces should be located in these healthy districts, and (if it ever be admissible in tactics to detach small bodies of men) detachments or guards could be furnished to the unhealthy parts of the country, which political reasons, or the necessities of the state, prevented being altogether abandoned.

The island of Jamaica affords an instance to illustrate this. From 1817 to 1836, a force of 2,578 on the average was distributed over it. Many of the stations have proved excessively unhealthy; but "while in some parts of the island half the troops, or at the rate of 500 per 1,000 of the strength, were swept away every year, in others the average mortality has not exceeded 32 per 1,000."*

				Ratio per 1,000 of Mean Strength died.	Average Strength.
Phoenix Park	-	-	from 1833 to 1836	29·	61
† Montpellier	-	-	"	30·	67
Maroon Town	-	-	from 1817 to 1836	32·5	190
Mandeville	-	-	from 1833 to 1835	35·	75
Fort Augusta	-	-	from 1817 to 1836	78·3	389
Lucia	-	-	"	91·	83
Stony Hill, nine miles north of Kingston	-	-	"	96·8	362
Falmouth	-	-	"	110·6	194
Port Royal	-	-	"	122·3	254
Up Park Camp, two miles north of Kingston	-	-	"	152·8	726
Port Antonio	-	-	"	162·5	137
Spanish Town	-	-	"	177·1	336

And though such differences exist, the island is only 160 miles in extreme length, and 50 in breadth, and could be traversed by troops from end to end in a few days. It is evidently, therefore, in our power to withdraw the soldiers from the stations where they have suffered so much, and to place them in those localities which experience has proved to be favourable to the European constitution. ‡

* Report, &c., 1838.

† The position of Montpellier has not been correctly ascertained; it is supposed to lie to the eastward of Stoney Hill, near the place marked *.

‡ Since these remarks were written, I am informed that (in 1844) this change has been introduced. Half a regiment of the Europeans has been stationed at Newcastle, and another half at Maroon Town; and a third West India regiment, 1,000 strong, has been raised to occupy the low country.

JAMAICA



Taken by permission from the *Illustrations of British Colonies*

Let us now turn to Ceylon, in which an average force of 2,149 men has been stationed since 1817. The principal stations are Colombo, Kandy, Trincomalee, Galle, and Niwera Elia which has been occupied since 1829. (Badulla and Ratnapoora, at one time stations, were abandoned in 1832.) The Table given of the rates of mortality will show that at some of the stations the ratio of deaths is quadruple what it is at others.

STATIONS IN CEYLON.	Ratio per 1,000 of Mean Strength Died.	Average Strength.
Galle - from 1817 to 1836 - - -	23·	182
Niwera Elia, from 1831 to 1836 - - -	24·	116·6
Ratnapoora from 1817 to 1832 (now abandoned)	42·7	54
Colombo - from 1817 to 1836 - - -	51·9	920
Kandy - " " - - -	60·7	433
Trincomalee " " - - -	91·4	284
Badulla - from 1817 to 1832 (now abandoned)	97·1	75

Considering the small size of the island of Ceylon, it cannot be necessary to submit to the loss of men which the unhealthy climate of some of the posts occasions. Indeed, the possibility of effecting a saving of life is often the only point requisite to be known, and this fact is sufficiently established by the preceding Table. From the superior degree of health enjoyed by the few troops stationed at Niwera Elia, we may form an opinion of the benefit that would result from making this central position the principal station in the island, and the passes leading into the low country, and the plains and alluvial lands below, could be guarded by the black or native troops, whose constitutions are fitted for the climate. Indeed this practice has been partially adopted already; "a detachment of the Ceylon Regiment or of the Pioneer Corps having generally been quartered about 12 miles from this station, for the purpose of keeping open an extensive pass, connecting this part of the country with the Kandy district."* Galle, alone, of all the other stations, can compete with Niwera Elia as to salubrity, but its situation at the extreme south renders it less eligible as a military position to command the whole island.

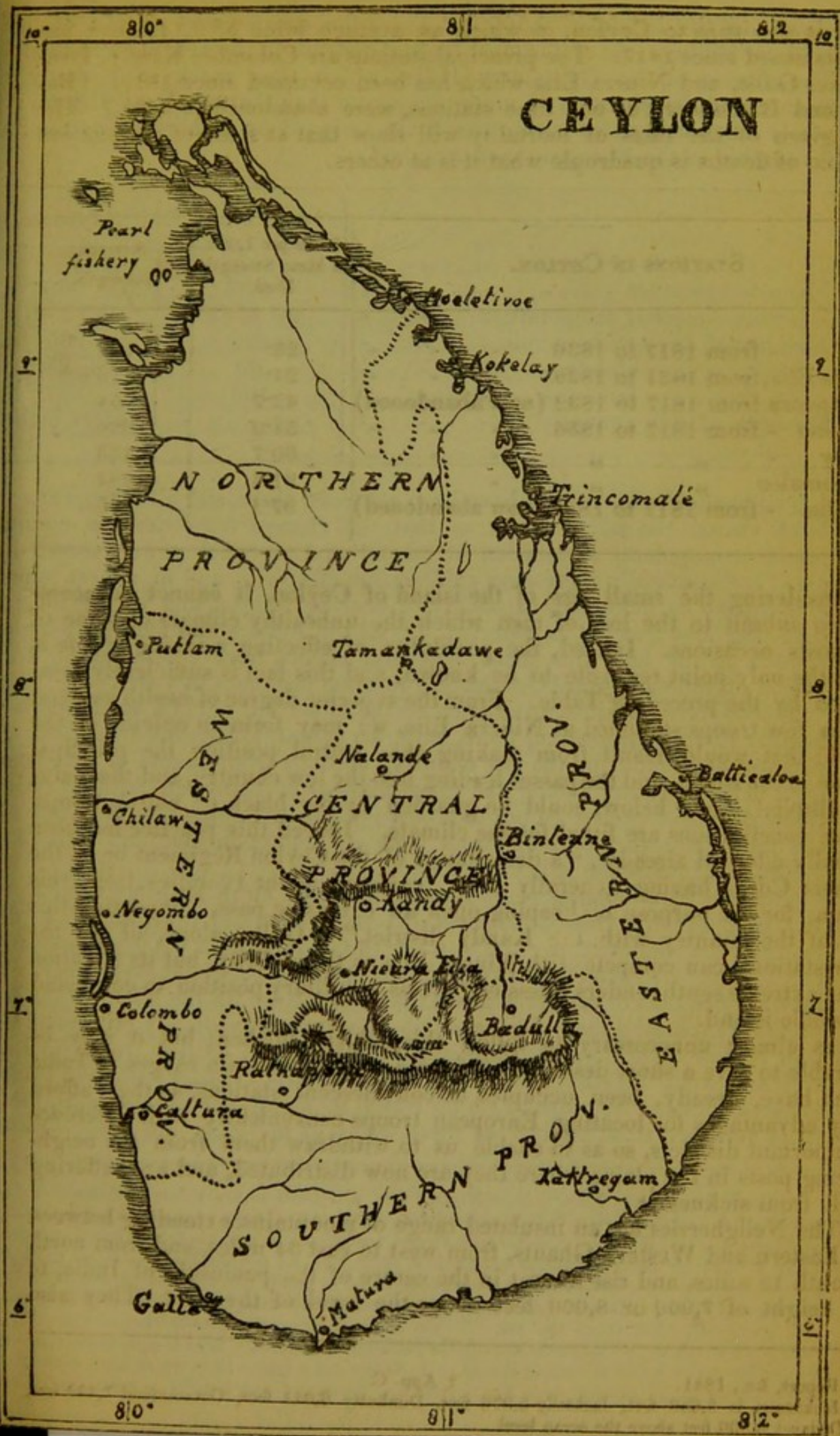
It is almost unnecessary to follow this subject further; but it may be desirable to give a short description of some of the mountain ranges in India which have, already, been occupied as convalescent stations, as they afford many advantages for locating European troops conveniently with reference to important districts, so as to enable us to withdraw them from the neighbouring posts in the plains where they are now distributed, and are suffering much from sickness.†

"The Neilgherries are an insulated range of mountains, extending between the Eastern and Western Ghauts, from west to east 34 miles, and from north to south 15 miles, and rise almost in the centre of the peninsula of India, to the height of 7,000 or 8,000 feet above the level of the sea.‡ They also

* Report, &c., 1841.

† App. C.

‡ Jackanairi is 5,659 feet, Jacktally 5,976 feet, Dimhutty 6,041 feet, Ootacamund 7,400 feet, and Dodapet 8,800 feet above the ocean level.



elevate to the height of 2,500 feet above the ocean a vast plateau of table land containing some of the most fruitful districts in the Madras Presidency. The climate of the Neilgherry Hills, which thus mark so strongly the features of the country, is more temperate than that of Great Britain; its whole range being also within the limits assigned by authorities as the most favourable to the European constitution."

	Great Britain.	Neilgherries.
Mean temperature - - - -	56.3	56.7
Extreme ranges of temperature - -	90° & 11°	73° & 31°
Number of days without rain - - -	220	265
" " cloudy - - - -	60	28
" " fair - - - -	160	237
Quantity of rain annually - - -	- - -	47.78 inches

The medical officers who have been stationed there, and all Europeans who have visited the hills, assure us that the change from the low country produces a general restoration of mental and physical power, shown by great and gradually increasing exhilaration of spirits, and in a most remarkable degree by increased capability of bearing fatigue, and of relishing and digesting food; and it is asserted by all the officers and families who have resided in the hills that these beneficial effects have continued for a long period of time afterwards, extending in some instances to years.

Troops have never been stationed on the hills; but out of a small number of healthy Europeans residing there, only two casualties have occurred; one from sickness contracted in the low country, and one from disease of long standing. The mortality among the large number of European children residing there does not exceed 40 per thousand; while in England, at the same age, the mean mortality of both sexes is 50 per 1,000; in Belgium it is 65 per 1,000, and in Sweden it is 85 per 1,000.

The mortality among sick Europeans gives more striking results. Of 147 sick officers, treated between February 1831 and 1834, only four died, being at the rate of 27 per 1,000, while in Great Britain the mortality is 15 per 1,000 of strength; and in the Foot Guards 24 per 1,000 every year. The mortality in the convalescent dépôt that was formed on the hills, for the same period, (excluding three deaths which occurred immediately on arrival) was 6 in 108, or 57 per 1,000, the same as that of the British troops in India, sick and well. We have thus entered into details, (remarks surgeon Baikie) because we have no proper data on which to found our observations, though it is obvious that neither of these rates of mortality are fairly available

* These districts are, Bellary, embracing an area of 12,980 square miles; Cuddapah, of 12,970 square miles, and Coimbatore, 8,280 square miles; these three districts possessing a population of two millions and a half of souls. Another, the Mysore territory, now held by British troops, situated between 11° and 15° north latitude, in length 210 miles, with an average breadth of 140 miles, forms part of the table-land, and attains an elevation of 2,000 to 2,500 feet, enclosed on two sides by the Eastern and Western Ghauts. At Bangalore, a plateau of 60 miles by 50, the surface is undulating and nearly 3,000 feet above the sea. To the north, after passing Nandydroog, the country falls rapidly, and towards Seringapatam the surface has a sudden descent. Seva Ganga, the highest mountain in Mysore, is 4,600 feet above the sea. In so elevated a region there are no large rivers, but the small streams which descend from the plateau are numerous, and fertilize a great portion of the country.

for comparison. From data furnished by Inspector-general Brooke (Returns from 1826 to 1832) we can estimate the probable mortality to which Europeans would be subject if stationed there. The deaths out of 60,954 living in India, amounted to 3,486, or 57 per 1,000, in the following proportions:—

Fever	-	-	15·4	Pectoral complaints	2·5
Liver	-	-	4·2	Bowel - - ditto	18·4
Cholera	-	-	11·5	Miscellaneous ditto	5·0

But from the fact that all endemic and epidemic diseases, and the four great scourges of the Europeans in the low country, fever, dysentery, cholera and liver, as a consequence of climate, are unknown, *we may safely predict, that the number of deaths, among a body of troops stationed on these hills, would not be much above the average mortality among the troops in Great Britain*;* and to learn the saving of life that might be effected by forming cantonments there, it is only necessary to examine the returns from neighbouring stations for 1842.

	Ratio of Deaths per 1,000 of Mean Strength.	Strength, 1842.
Neilgherries; no exact data, but supposed mortality - - - - -	20·	—
Cananore - - - - -	52·2	613
Bangalore - - - - -	29·	2,167
Trichinopoly - - - - -	40·4	420
Arnee and Arcot - - - - -	56·7	1,551
Bellary - - - - -	94·3	530

“The importance of the Neilgherry hills, as a central position, may be learned from the fact, that about 4,000 European and 10,000 native troops are distributed at Mangalore, Cananore, Palamcottah, Mercara, Trichinopoly and Bangalore, the principal stations at their base. The distance from the Neilgherry hills to Calicut is 56 miles; to Cananore 130; to Trichinopoly 153; Bangalore 176, and Madras 393.

“The nature of the approaches to the hills affords the greatest facility of access. The Conoor, Goodooloor and Segoor passes, one on the north, the other on the south and west, are open at all seasons and at all periods of the monsoon and are practicable for wheel-carriages; and if the Koondah Ghaut were completed, a regiment could, in three or four marches, reach Arricole on the Beypore River, whence it is navigable at all seasons to its embouchure at Calicut, the distance being a little more than 30 miles.”

In the Bombay Presidency, a convalescent station has been formed at Malcolmpett on the Mahabaleshwur hills, which form a part of the western chain that stretches from Surat to Cape Comorin, though the hills are a great measure insulated from the surrounding country. The site selected for the position of the sanatorium is in 17° 56' N., and 73° 30' E., 24 miles due east, and at an elevation of 4,500 feet from the ocean, on the seaward westward slope of the mountain. It is thus freely exposed to the influence of the sea-breeze, while it is protected against the force of the easterly wind.

On the western side the hills rise precipitously from the Concan, over

* Letter from Surgeon Baikie, M.D., dated 1st May 1840, to the Secretary to the Madras Government.

which they tower to the height of 4,000 feet; and to the eastward they are elevated 2,000 feet above the table-land of the Dekhan. The surface of these hills has an area of 50 or 60 miles, undulating, and in some parts hilly, which prevents the rains collecting on the tenacious clayey soil, formed by the decomposition of the laterite, or iron ore rock, of which they are composed. Their elevation is not sufficient to raise them above the influence of the monsoon, and the heavy rains that pour on the hills cause all the sick to abandon them.* They are again crowded during the hot season by invalids, and others from the neighbouring stations, who seek refuge from the burning heats of the plains, to gather fresh vigour from the temperate climate, and interest the mind with the scenery of the hills. There are several important stations for European troops at short distances from those hills.

On the lower ranges of the Himalayas, on the north and north-west frontier of the Bengal Presidency, stations for convalescents and regiments have been formed, taking advantage of their elevation above the sea, to secure the health of the troops required in that important quarter of our territories. Subhathoo, in north latitude $30^{\circ} 58' 12''$, and east longitude $76^{\circ} 58' 37''$, is now a British cantonment, romantically situated in the district of Bareilly, 4,456 feet above the ocean. One European regiment occupies the station.

Almora is built on a ridge of mountains 5,400 feet above the level of the sea, in lat. $29^{\circ} 35'$ north, and long. $79^{\circ} 40'$ east. The Almorah district is separated from Bareilly by the Kumaon hills, and, properly speaking, is only a subdivision of the Kumaon district. Two corps of artillery and two regiments of native infantry are stationed at Almorah. At Simla (7,000 feet) there is only an irregular corps stationed. The Government have there founded a delightful station for their European invalids. "The portion of the Himalayas visible from Simla is a depressed continuation of the chain, extending from the emergence of the Sutlej, through the snow, to an abrupt limit bordering close upon the plain of the Punjab, near the debouchure of the Ravee. Few, if any, of the detached peaks visible rise above 20,000 feet, though the crest of Jumnotree may be seen from the highest point in Simla, which is a conical hill named Jacko, 8,120 feet above the level of the sea.†

It may be seen from the stations already formed, that the executive authorities have not overlooked the importance of these elevated regions as the means of securing the health of the European stranger; and if others of the hill ranges, which cross our territories, be examined, many tracts would be discovered where the British troops might be located, above the heats and diseases of the plains, although there are also many places on the plains where

* Bombay annual fall of rain:—At Khandalla, 1,740 feet above the sea, and 30 miles inland, 38·75 inches of rain fell, while at Poonah, 40 miles further eastward, only 23·43 inches fell. The average fall at the sanatorium, on the Mahabaleshwur, 25 miles due east from the sea, and 4,500 feet above its level, is 239·80 inches annually.

Amount of Rain during June, July, August and September 1842.

	Sanatorium Mahabaleshwur.	Pamghurry.	Poona.	Bombay.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
Monsoon, 1842	289·37	48·67	14·77 $\frac{1}{2}$	87·33

The heavy rains will prevent the Mahabaleshwur being made the site of cantonments, but as a sanatorium they are invaluable.

† Montgomery Martin, Hist. of British Colonies.

our European soldiers might be advantageously located; and even with the convalescent stations already established at Maroon Town, at Jamaica; at Niuera Elia, in Ceylon; on the Neilgherry and Mahabaleshwur hills, in southern India; and at Darjeling, Missourie, Landour and Simla, on the southern slope of the Himalayas, the authorities have commenced only where they should have ended; for if such localities be valuable for restoring the injured health of Europeans, they must be still more so as the means of preserving it; and we hope the day is not far distant, when they may be made use of for such a purpose.

When selecting a district for the location of a force, it must not be forgotten that the climate or locality suitable for one race may be very unfavourable to the health of another.

The mountain regions, or even the table lands of India, for example, though promising great advantages to the British troops, may prove highly prejudicial to the constitutions of the men who form our native regiments; for the natives of warm countries appear to suffer as much in a cold climate, as the races from the temperate parts of the earth do when dwelling in the plains of the tropics. Indeed, we are warned of the danger of removing those who have been born in the tropics to the frigid climates of our earth, by the mortality that has occurred among them by our doing so, as in the instance of the negro troops in garrison at Gibraltar, who lost 63 per 1,000 of their strength in 1817 and 1818, while the average ratio of deaths among this class of troops in the West Indies has only amounted to 40 per 1,000 annually. A similar increase in the rates of mortality took place also at Niuera Elia, in Ceylon, which "though healthy for Europeans, has been by no means so favourable to the health of the *black troops*, particularly the negroes, who suffered in a remarkable degree. Amongst 51 stationed in the vicinity, 15 deaths took place in 1835, whereof five were from affections of the lungs."* Where the force consists solely of Europeans, undivided attention can be given to the selection of stations most favourable to their healths; but in India, where Europeans and native soldiers are usually brigaded in masses together, places must be sought for that will, in some degree, suit the constitutions of both descriptions of troops.

If an impression has been taken from the previous remarks that the tablelands and mountain ranges are the only places within the tropics where healthy situations for British soldiers are to be found, no such impression is intended to be conveyed; indeed the low rate of mortality occurring at Galle (23 per 1,000), and at Poonah, (23 per 1,000), and in several other posts, sufficiently establishes the fact, that there are many localities in the low countries of the tropics highly favourable to their health, though we may more likely meet with stations suitable for the European constitution, at a considerable elevation above the sea, and now that it is known that marked differences as to salubrity exist even in neighbouring stations, and that a great saving of men and money may be effected by judiciously locating an army, the importance of instituting a search for such healthy positions will be acknowledged; and it is only by correct statistical returns and reports that this invaluable information can be obtained.

* Reports, 1841.

APPENDIX.

APPENDIX (A.)

“ Maroon Town, which has been so long occupied, is a post among the Trelawny mountains, upwards of 2,000 feet above the level of the sea. It is surrounded on all sides but one by still loftier mountains, clothed to the summit with stately trees, exhibiting every variety of foliage. The view is open to the north east, and exhibits a vast expanse of sea and land scenery. The whole extent of ground occupied by the garrison, is about 200 acres, much interspersed with small hillocks and valleys, and these eminences have been chosen for the site of the houses and barracks erected for the accommodation of the troops. When it is mentioned that after deducting the deaths of those who had been sent to Maroon Town for change of air, and which, properly speaking, do not belong to the mortality of the place, the actual mortality of the station has not annually exceeded 22 per 1,000 of the strength. While the average mortality of all the stations in Jamaica has been 143 per 1,000 of mean strength, it needs not to be pointed out how great a saving would have been effected had the troops in Jamaica been all stationed there, or distributed among the posts, Phoenix Park, Montpelier or Mandeville, where the average ratio of mortality has been but 31·3 per 1,000 of the strength”.*

APPENDIX (B.)

“ Ceylon is naturally divided into two extensive tracts of country, differing very materially both in climate and physical aspect. The upper occupies nearly the centre of the island, and consists of a broken mass of highlands towering to the height of many thousand feet; while the lower is merely a level belt of ground varying from 30 to 40 miles in breadth, into which the elevated regions of the interior sink precipitously on all sides except the north, where they stretch away in a low continuous chain, dividing the waters which flow towards the east coast from those which run westward into the Gulf of Manaar.

“ The summits of the high ground in the interior frequently stretch into a considerable extent of table land, which when encircled by hills presents the appearance of an extensive basin. In a situation of this description, at an elevation of 6,200 feet above the level of the sea, stands the plain of Niwera Elia, about four miles in length and one and a half in breadth, on which a military station was established in 1829, owing to the advantage anticipated from it as a convalescent post. On every side the plain of Niwera Elia is encircled by lofty mountains, one of which rises 2,000 feet above the station, and consequently must be 8,200 feet above the level of the sea. The climate, though very invigorating after the heat of the sea-coast, is described as too bleak and variable to be pleasant. To those who have been long resident in the low grounds, the mornings and evenings are very cold, for the thermometer sometimes falls to 29°, and ice is formed of considerable thickness. It seldom rises above 70°, and Europeans can take exercise in the open air, even during the hottest period of the day, without experiencing the slightest inconvenience.”†

* Report, &c., 1838.

† Ibid. 1841.

APPENDIX (C.)

Mountain regions and tracts of table-land are to be met with in most of the islands and continents within the tropics, where, from the elevation above the plains, the climate, temperature, and even the character of the diseases bear a strong resemblance to those of the temperate countries of Europe; and from the experience we have already acquired, these highlands promise to furnish the means of preventing sickness among Europeans, by enabling us to station them above the heats and diseases of the plains. The height that is requisite to escape the diseases and the epidemics that occur with such intensity in warm climates, is uncertain, and it varies probably in different parts of the same country.

"At Sierra Leone, the barracks, though at the height of 400 feet, have frequently been the site of greater mortality than the lowest situation in town; and when a body of men was removed to the village of Wilberforce, at an elevation of 500 feet, with a view of keeping them free from fever, they suffered even to a greater extent than the shipping in the harbour."—(Report, 1840.)

"The instances of Fort St. George at Tobago, Morne Fortuna at St. Lucia, and Morne Bruce at Dominica, demonstrate that mere elevation to the height of 600 or 800 feet, instead of securing a healthy position, seems rather to have a reverse tendency." The records of the mortality at Stony Hill, in Jamaica, where the mortality with reference to the average of deaths from fevers, in the whole island, has been as 101·9 to 70·5, show that an elevation even of 1,360 feet is insufficient to secure an immunity from the remittent fevers of Jamaica." But, remarks Colonel Tulloch, "the researches of Humboldt on this subject have tended to establish that the yellow fever of the West Indies is never known beyond the height of 2,500 feet." (Report 1838.)—In the East Indies, however, this degree of elevation does not seem sufficient to secure the troops from attacks of fever, nor from the scourge of epidemic diseases. In Berar, Hyderabad and Candeish, and near the Sautpoora range of mountains, table-lands that range in altitude from 1,200 to 2,000 feet above the level of the sea, the fevers are so deadly at certain seasons, that few who attempt to pass through them escape; and while Seringapatam, which has 2,300 feet of elevation, was garrisoned, the natives of the country, as well as the European strangers, suffered so much from remittent fevers, that the fort was abandoned, and the French Rocks, six miles distant, now forms the station. It has been the same in Ceylon. Remittent fever occurred at Kandy in 1824, as an epidemic, and cut off a fourth of the garrison; and so many men were carried off by the same disease at the station of Badulla, that the place has not been occupied by European troops since 1832. The annual mortality there was 97·1 per 1,000 of mean strength, and 59·3 of this, was from fever alone; yet Kandy is 1,676 and Badulla is 2,100 feet above the sea's level. At 3,000 feet above the sea, amongst the passes leading to the Neilgherry Hills, the agent that occasions fever is so powerful, that few Europeans who have slept a night in them have escaped an attack, and of those attacked, almost all have died. It is the same with cholera; a limited degree of elevation seems to have little effect in lessening its frequency or its intensity, even amongst the indigenous inhabitants of the country; for it often spreads with sweeping violence among Europeans and natives, in the stations in the Dekhan, which range from 1,600 to 2,000 feet above the ocean's level; and in 1819-20 and 1832 it also occurred among the Europeans stationed at Kandy in Ceylon, which is 1,676 feet high. Even at 2,400 feet in height above the level of the sea, at Bangalore, in the Mysore

country, cholera is by no means of unfrequent occurrence, though the native population in the crowded bazaars, are there the chief sufferers. But when we attain an altitude of 6,000 or 7,000 feet, such as that of the Neilgherry Hills, although an individual case or two has occurred, yet neither on these hills, nor at Niura Elia in Ceylon, 6,200 feet in height; neither at the Mahabaleshwur Hills, near Bombay, nor at Simla or Darjeeling, has cholera ever appeared as an epidemic. There are, therefore, good grounds for believing that by rising to the cold regions of the atmosphere amongst the mountains and table-lands of countries within the tropics, the natives of northern Europe may escape most of the diseases which destroy their countrymen who reside in the plains, and that when thus favourably stationed, the mortality from all causes will not, on the average of a series of years, materially exceed that to which an equal number of European troops would be subject in the capital of their native country.



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