The means of practically applying the principles of medical geography, for the preservation of the health of soldiers and seamen in foreign climates / by Dr. Bird.

THE MEANS

OF PRACTICALLY APPLYING THE

PRINCIPLES OF MEDICAL GEOGRAPHY,

FOR THE

PRESERVATION OF THE HEALTH OF SOLDIERS AND SEAMEN IN FOREIGN CLIMATES.

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Last year I laid before you the principles of Medical or Noso-Geography; in other words, the facts of physical geography and vital statistics, inductively used for investigating the laws under which health and disease are distributed through the human family, and in various latitudes. On that occasion I brought to notice, how that this promising field of research forms only part of medical etiology, or a knowledge of the causes of disease, associated with geographical situation, and the climatology of particular countries; and that if those entrusted with the health of, or in command of, either soldiers or sailors in those countries, would but rightly appreciate the importance of the duties committed to them, they would endeavour to acquire useful knowledge of the influence of climate on health, and of subjects connected with the treatment as well as the prevention of disease.

The more material agencies which geographically regulate not only the diversities of vegetable and animal structure, but the production of disease also, are the geographico-meteorological causes of atmospheric temperature and humidity, measured by isothermal lines, which connect places having the same mean temperature, but which differ sensibly from the lines of latitude. The mean temperatures calculated from an equatorial mean of 81° 50′ Fahr.,

according to Dr. Brewster's formula, and which differ considerably from the mean temperatures obtained by observation, are given in the annexed Table from Daniell's Elements of Meteorology:

	Latitude.	Observed Mean Temperature.	Mean Temperature calculated by Formula.	Difference.
Equator - - -	0° 0′	81°·50	81°·50	0°·00
Columbo - -	6 58	79·50	80·90	1·40+
Chandernagore -	22 52	75·56	75·10	0·46—
Cairo - - -	30 2	72·82	70·56	1·76—
Funchal - - -	32 37	68·54	68·62	0·08+
Rome - - -	41 54	60·44	60·66	0·22+
Montpellier - -	43 36	59·36	59·	0·36—
Bourdeaux - -	44 50	56·48	57·82	1·34+
Milan - - -	45 28	57·18	58·28	1·10+
Nantes - - -	47 13	54·68	55·35	0·67+
St. Malo - - -	48 39	54·14	53·85	0·29—
Paris - - -	48 50	51·89	53·65	1·76+
Brussels - - -	50 50	51·80	51·47	0·33—
Dunkirk - - -	51 20	50·54	51·25	0·71+
London - - -	51 30	50·36	50·74	0·38+
Bushey Heath - -	51 37¾	51·20	50·58	0·62—
Kendal - - -	54 17	46·02	47·58	1·56+
New Malton - -	54 10	48·28	47·53	0 75—
Lyndon - - -	54 34	48·90	49·37	0·47+
Dublin - - -	53 21	49·10	48·65	0·45—
Copenhagen - -	55 41	45·68	45·95	0·27+
Edinburgh - -	55 57	46·23	45·64	0·59—
Carlscrona - -	56 16	46·04	45·46	0·58—
Fawside - - -	56 58	44·30	44·26	0·04—
Kinfauns - -	56 23½	46·20	45·12	1·08—
Stockholm - -	59 20	42·26	41·57	0·69—
Upsal - - -	59 51	42·08	40·94	1·14—
Abo - - -	60 27	40·00	40·28	0·28+
Umeo - - -	63 50	33·08	35·96	2·88+
Uleo - - -	65 30	33·26	34·38	1·11+

These mean temperatures are usually higher in the same latitude of the old world than of the new, and are greater in northern than in southern latitudes. Thus the isothermal line of 59° Fahr., traverses the latitude of 46° in Europe, but descends to latitude 36° in America. The general causes which disturb the symmetrical distribution of temperature, are, the annual variations of the upper equatorial and lower polar currents of the atmosphere, the difference of contained humidity, the unequal distribution of land and water in various countries, the peculiar nature of the surface land, and its relative height above the level of the sea. All these causes have more or

less influence in determining the local temperature or climate of places, and in fixing the isothermal lines that mark out the zones of disease.

It can be asserted only in a limited sense, and relatively, that certain class diseases are mainly *dependent* on, or *independent* of, temperature and moisture. Specific diseases of a miasmatic and zymotic kind are materially under the influence of these meteorological causes, aided by the concurrent ones of topographical situation, geological nature of and elevation of the soil, state of the vegetation, and domestic habits of the people. Those diseases, again, which mainly arise and prevail *independent* of such influences, or diseases called *dyscrasial*, which are of constitutional origin, and result from depraved conditions of the blood and impaired nutrition, are not limited by isothermal lines to particular quarters of the globe.

The class of miasmatic diseases and those of a self-generated contagious type, as remittents, yellow fever, plague, genuine typhus, and cholera, require a fixed amount of temperature and moisture for their production and prevalence. Dyscrasial or constitutional diseases of depraved nutrition—as cachectic ulcers, rheumatism, scurvy, and consumption, which arise from a special cell-degeneration in particular bodies, are not absolutely, but relatively, independent of temperature and atmospheric humidity; although consumption is more prevalent in the tropical than in the arctic regions.

The zones, or belts of disease, thus geographically marked out on the globe, are the *tropical*, *temperate*, and *polar* zones.* The north limit of the first is formed by the isothermal line of 77° Fahr. This line ascends somewhat in summer, when the sun is north of the equator, and descends again in winter, when the sun is to the south of it. While it forms the northern limit of the tropical zone, where we find the worst forms of malarious, intermittent, remittent, continued, and yellow fevers; and of those diseases found in alliance with them, as dysentery, diarrhœa, cholera Indica, and affections of the liver ; it is also the southern bar to the prevalence of epidemic *contagious typhus*, which is the proper and peculiar product of the next, or temperate zone; whose limit southwards is the isothermal

* No map of these zones is here given, as the reader may find one in Mr. Keith Johnston's Atlas of Physical Geography.

line of 77° Fahr. and northwards that of 41° of the same scale. The polar zone, again, which extends beyond these two zones, is directly opposed in climate to that of the tropical zone. Its southern boundary is the line of 41° Fahr., while its northern limit extends 8° or 12° below the zero of Reaumur.

The temperate zone embraces the extreme climatic conditions of the two other zones, under the seasons of summer and winter. At these periods, the prevailing disorders, to which armies and military masses moved from one country to another are peculiarly subject, will partake alternately of the character of diseases prevalent within the tropical and polar zones. The results and experience of the Crimean expedition have afforded ample evidence of this fact. In the Crimea more particularly, and in all the European countries of this zone, both soldiers and seamen, but especially the former, will suffer greatly in summer from diarrhœa and dysentery, from intermittents, fevers of a remittent and continued type. The latter, under bad diet, and imperfect ventilation of the soldiers' huts and hospitals, soon degenerate into genuine *contagious typhus*. This true typhus, once so prevalent, and now but rarely seen, under a better and more scientifically administered sanitary system, as well as the true glandular plague, have their special habitation in this zone, between the thirtieth and fortieth degrees of northern latitude; and, though occasionally propagated beyond these limits, by a secondary and specific poison generated from human bodies, they have evidently a distinct primitive origin from atmospheric agencies.

Yellow fever, also, from the tropical regions, makes occasional incursions into this zone, when favoured, during summer, by tropical identity of climate. Under high degrees of temperature it has appeared, both at Gibraltar and Cadiz, and in America southwards beyond its usual limits, under like favouring circumstances. But, as soon as the temperature falls below 55° of Fahrenheit, the importation of yellow fever into this zone becomes impossible, and supersedes the necessity of quarantine. Plague, like the yellow fever, is limited to low, filthy localities, but differs from it by being destroyed by high degrees of temperature. Both are limited in their prevalence by elevation of site above the level

of the sea; such elevation being associated with decrease of temperature, exerts the same agency against their prevalence as do certain isothermal lines and increase of latitude.*

Having thus briefly recapitulated the principles of medical geography, which formed the chief heads of a former lecture, I shall, on the present occasion, point out the means of practically applying such principles for the preservation of the health of soldiers and seamen in foreign climates. Political motives, and the circumstances of warlike operations, frequently render it necessary that both soldiers and seamen should be located in unhealthy situations; but timely precautions, and the resources of hygienic knowledge, are capable of averting their injurious effects, when unacclimated masses of men are exposed to those external and internal agencies which pervert the normal condition of individual constitutions. When we reflect that, in this matter, causes susceptible of removal are, from prevailing ignorance, allowed too often to exaggerate the evils of disease, incident to assembled multitudes; we may well wonder why, until very lately, so little should have been done to apply the resources of professional knowledge, for the prevention and amelioration of diseases in our military settlements, and more particularly those consequent on warfare.

While soldiers are exposed, alike with persons in civil life, to topographical and atmospheric influences peculiar to the different geographical zones of disease, they are somewhat differently placed in regard to other agencies, to which the unfettered emigrant is not exposed, and to which he may at least accommodate his constitution. The principal of such agencies are the unacclimated and unmodified constitutional states of soldiers and seamen, suddenly removed from one geographical zone to another; the condition of their diet, drink, and cooking; the state of their clothing, barracks, berths, huts, hospitals, camps, and bivouacs; their marches, ordinary exercises, habits, and discipline. On the subject of these, certain rules are laid down for the guidance of men in the army and

* Dr. Lawson has forwarded home a paper on the late epidemic outbreak of yellow fever at Jamaica, in which it is statistically shown that this disease is occasionally prevalent beyond the now fixed limit of elevated site.

navy, from which they are not permitted to deviate, whether such rules may have been laid down with due regard to sanitary results or not.

In regard to acclimatation, we may observe, that not only do the states of the blood but the physiological conditions of the long resident and recently imported inhabitants differ. No better proof of this need be cited than the fearfully destructive effects of yellow fevers in the West Indies, which carried off thousands of our soldiers and seamen at the commencement of the last war, while the residents of those islands were comparatively exempt; and had the barracks and hospitals then constructed in those colonies been placed in better selected and more elevated sites than was the practice in those days, a vast saving of life and expense might have been earlier secured for this country.

From the high temperature of the tropical zones, and the consequent diminution of inhaled oxygen, the blood of the European becomes more loose and venous than in the temperate zone, is distributed more in the venous than arterial trunks, and gives rise to an increased elimination of bile by the liver; whose vicarious action, concurrent with the increased functions of the skin, is set up in aid of the respiratory function, in order to carry off the superfluous carbon of the blood. The necessity for producing the same continuous supply of animal heat now ceases, and with this ceases also the appetite for large quantities of nitrogenous and oleaginous food, which had been previously vigorous. Neither digestion nor respiration is in a condition to supply any longer the production of abundant rich blood, which is no longer wanted for the necessities of the system. Should nature, under such circumstance, not be thwarted by improper indulgences of drinks and diet, she increases those eliminating functions of the skin and liver by which the systemic blood is rendered poorer in quality, smaller in quantity, and suitable to the wants of the body. Dr. John Davy ascertained that, under high degrees of temperature within the tropics, the heat of the human body at first increases with the temperature of the air, and falls as the atmosphere cools, within certain limits.

Although his researches be little more than an approximation to truth, they have clearly established that, on first landing in tropical

climates, the standard heat of Europeans is raised two or three degrees, accompanied by febrile symptoms; that the reduction of the body's temperature to a normal state requires temperance and abstinence from alcoholic drinks, moderation in eating, and the sparing indulgence in animal food; with avoidance of all causes of excitement increasing vascular action, and particularly exposure to the sun. The tropical new comer should at the same time use cooling drinks, as sherbets of various kinds, and frequently have recourse to tepid ablutions of the body. In the East Indies a large proportion of the inhabitants use an almost exclusive vegetable diet; and in the West Indies the black and brown races indulge sparingly in animal food. The former, in respect to Europeans, are of comparatively feeble constitutional power, which exempts them from those more severe and venous congestive forms of fever that prove so destructive of the latter. This very feebleness makes native soldiers, *or Sepoys*, more subjects of rheumatism and emaciation after mild forms of intermittent fever, predisposes them to destructive ulceration, and renders them more susceptible of injury from large doses of mercurial preparations, and like heroic remedies which reduce the fibrinous condition of the blood. The black and creole races of the West Indies, too, though more liable than Europeans to suffer from diseases of defective nutrition, are less susceptible of those generated by plethora and constitutional vascular excitement. Cerebral and nervous affections are here more severe and common than in the temperate zone, and require for their prevention rigid abstinence from alcoholic stimuli. But many tropical diseases, among soldiers, are caused by sudden refrigerations of the body and vicissitudes of temperature. The period for acclimating Europeans is about two years.

In the temperate and polar zones again, where vital action is more energetic, and the blood more abundant and arterial, Providence wisely provides the increased density of the atmosphere, for maintaining the uniform temperature of the body, by the increased quantity of inspired oxygen, and a greater appetite for hydro-carbonized or heat-producing articles of diet and drink, such as starch, oil, fat, and hydro-carbonized stimuli. But just as the excess of carbon and hydrogen, in fat and oleaginous food, is requi-

site in very cold climates for maintaining bodily warmth, so is a due proportion of *nitrogenous* or nutritive food also necessary. Without a sufficient supply of *nitrogenous articles* of diet, animal and vegetable, containing flesh-like or proteine compounds, the nutrition of the body fails, its vital power becomes enfeebled, and scorbutic disease is established, whether the *diatetic restriction* be to the animal or vegetable kingdom. Diversified diet is thus necessary for the sustenance of the body in healthy degrees of vigour, even in the temperate zone of Europe; yet the natives of hyperborean regions, who cannot obtain farinaceous articles of diet, subsist exclusively on animal food of the coarsest kind, without degenerating in physical condition. Their purely animal diet of an oleaginous kind requires vigorous assimilating organs for its elaboration; and, as a greater quantity of oxygen is absorbed into the blood, a greater production of animal heat compensates for its more rapid substraction by surrounding cold media. The inhabitants of the Arctic regions, when brought to this country, suffer much from the heat of our summer and autumn; and in this respect the Greenlander is similarly situated as the European, when transported for a few weeks to a tropical climate. The established functional actions of the animal economy, associated with certain concurrent conditions, generate more than the requisite degree of heat for the wants of the system; and, as the quantity abstracted is less than that produced, it rarifies and expands the circulating fluids, exalts nervous irritability, and increases vascular action.

The influence of foreign climates has been specially elucidated by the elaborate statistics of our army and navy. Investigation into the principles of medical geography, then, in relation to such influence, and the circumstances to which particular places are indebted for their salubrity or otherwise, may be viewed as the theory of *Hygiene*, or a knowledge of the external and internal causes of diseased action. The means of destroying these morbific causes, or the practical application of this knowledge for the prevention of disease among soldiers and seamen, in various climates, is the object of practical military and naval Hygiene. This is a subject of the greatest utility when directed to the adoption of measures likely to

diminish the great loss of life annually experienced in our settlements abroad. The true and practical end of Hygiene is to point out the best means of assimilating the human constitution to new employments and climates, and to recommend such measures as are sure of neutralising the effects of hurtful agencies, to which individuals or multitudes may be exposed. The means best adapted for obtaining the first end in view, or the acclimatation of the raw soldier or sailor to new climates, consist in the proper adaptation of their diet, clothing, and duties to the exigency of different seasons, and changes of external temperature and climate. Those calculated to avert the baneful consequences of the latter are such as are calculated to promote healthy conditions of barracks, huts, and hospitals; and to invigorate the constitutions of the men under command by well-regulated systems of diet, clothing, exercise, amusements, education, and punishments. In endeavouring to fulfil a promise I made, at the conclusion of my last year's lecture, to embody some practical recommendations and rules in reference to varied causes of disease, and with the object of preserving the health of troops, I shall now point out the practical measures most suitable for preserving the health of military and naval masses, in accordance with the principles of medical geography, which have been brought before you.

In 1821–30 the mean annual proportion of deaths for the entire Prussian army was 11·7 per 1,000 men, a very low ratio of mortality compared with other armies. This army is, however, composed of young men compelled only to three years' active service, and subject to but few changes of locality. The civil population of Berlin, at the same age, twenty to twenty-five, gave 10 deaths to 1,000 living. But the British army in 1819–28 furnished 15 deaths per 1,000 in the United Kingdom, 57 in troops serving beyond its limits, and 37 for the entire army. Taking the mortality of the British army within the kingdom at 1, it is 1·3 beyond the tropics, and 4 in intertropical regions. The present condition of the British navy demonstrates irresistibly the power of *hygiene* in diminishing the ratio of mortality. It was 13·8 per 1,000, or from internal diseases alone 11·8, for the period 1830-36, while seventy years ago it was 123, and less than forty years ago, 30. Official

records attribute this improvement to better diet, free ventilation, less severity of punishment, diminution of the rations of spirit, and less money left at the men's disposal. To the more prominently useful sanitary measures in regard to these objects I shall now advert. And, *first*, in regard to

Diet and Drink.—I have already given a brief outline of the peculiar physiological condition of well-nourished Europeans, at their first entrance into tropical climates; and have pointed out that with the change of circumstances a corresponding change of their usual articles of diet and drink becomes absolutely necessary, in order to maintain intact the body's organic functions. That, which the majority of individuals would not, in this respect, willingly or prudently submit to, is naturally forced on their acceptance, and against their artificial inclinations. The appetite for animal food is lessened, the inclination for cooling acid beverages in preference to spirituous drinks or malt liquors greatly increased, and the due performance of the cutaneous and other excretory functions, accompanied by gradual abatement of nervous excitement, thus duly maintained; but, should the harrassing nervous irritation and thirst, to which soldiers and seamen under such circumstances are exposed, ever induce them to seek relief from increased potations of fermented liquors, the very opposite of these healthful changes will be the consequence. The excretory functions of the skin and other eliminating organs are suppressed, the circulating fluids rendered more carbonaceous and impure, the nervous irritability rendered more oppressive, and all the symptoms of tropical fever with its dangerous accompaniments established. Colonel Sykes, in his valuable paper on the "Vital Statistics of the Indian Army," has, from the evidence of figures, given explicit testimony to the benefit of abstaining from the excessive use of fermented liquors under such circumstances; and, that when animal food is unsparingly used, and total abstinence from fermented liquors is not observed, the substitution of beer for distilled spirit will be the least injurious of pre-established habits, which proved not unhealthful in colder climates. He rightly associates the comparative healthiness of the Europeans of the Madras army with the increased consumption of malt liquors

by the soldiers of that presidency, and the gradations of mortality of the Bengal and Bombay European troops as partly influenced by the quantity of spirits respectively consumed. "I have a strong conviction," says the Colonel, "that much of European disease in India is traceable to over-stimulus, and that the mortality among the Europeans troops will not be lessened until the European soldier is improved in his habits, until he is made to understand that temperance is for the benefit of his body, libraries for the benefit of his mind, exercise for the benefit of his health, and savings banks for the benefit of his purse."

The diet of soldiers and seamen in tropical climates might be advantageously made a little more varied, by diminishing the proportion of nitrogenous or animal food, and increasing the quantity of farinaceous articles of diet, or of albuminous culinary vegetables. In the cold weather of the temperate zone, and in the polar zone particularly, increased proportions of animal and fatty food, with a moderate allowance of fermented stimuli for drink, either beer or wine, become necessary for the preservation of vigorous health; but if the same habits of eating and drinking be continued in hot climates, they are followed by their natural penalty, rapid disease, and premature death. Many have recourse to stimulants, in the vain hope of relieving the languor of body and depression of mind, which naturally attend a first residence in such climates, but they are soon cut off, the victims of their own imprudence and temerity. Fresh provisions of good quality, or salt meat in small quantities, free from septic tendency, and sufficiently cooked, are absolute requisites for the climates of every zone. The provision of iced sherbets and coffee in regimental canteens, and the introduction into the army of an evening meal for the soldiers, would be useful improvements on the system of diet. If spirits be drank at all, they should be so after being well diluted with common water, or, what is better, with effervescing soda or potass waters.

We cannot, moreover, doubt the pernicious effects that follow the habitual use of foul water, whether in camps or cantonments. The continuous introduction, from this source, of septic matter into the system predisposes it to be acted on by other morbific causes, even should this itself not become an exciting cause of disease. In tropical

climates it is either raised from wells, or obtained from tanks in which rain-water is collected. In either case it is impregnated largely with animal and vegetable matter, and becomes quickly fœtid and putrescent. Remedial measures for correcting these evils are simple, and not expensive. These are,—keeping clean the reservoirs, boiling the water, and filtering it through charcoal. Small additions of wine or spirit to bad water may be sometimes advisable, but its purification is the more salutary process, as the action of alcoholic drinks on the blood, assisted by increased temperature, is to devitalize this pabulum of life.

Dress.—With regard to *dress* or *clothing* for soldiers and seamen, it is desirable that this also should be suited to the climatic conditions of the different zones. The furs and woollen clothing which are so well adapted to retain the body's animal heat, in the temperate and polar zones, are altogether unsuited to its conditions in either tropical zone. It is not necessary that, in this matter, appearance should be altogether sacrificed to convenience, but surely it is quite unnecessary that, except on parades, either officers or soldiers should be buckled up in woollen clothing on all occasions, or that seamen in the performance of their ordinary duties, with the temperature at 96 to 100 of Fahrenheit, should be clad as under a polar sky. For hot climates a cool linen dress, made according to a pattern, should be officially sanctioned, so that one of the most common causes of disease, sudden refrigerations of the body, after excessive perspiration from over-clothing, might be prevented among the men. It is impossible to prevent soldiers from throwing off their coats to cool themselves after a march, drill, or parade, and the addition, therefore, of a flannel under-waistcoat, or flannel undress, must be at all times, in warm climates, an important addition to the soldier's dress. But defective clothing again of the soldier or seaman in cold climates, is frequently a main cause of their ill health, particularly when predisposed to pulmonary disease. Here flannel under-waistcoats and waistbands should, in general, be provided as absolute requisites; it being kept in remembrance that neither an over-coat nor any amount of extra clothing, in order to preserve warmth, can be a substitute for flannel next the skin, over whose functions it has a special sanitary influence.

In rules for the preservation of health, the benefit of attending to the condition of the cutaneous surface is scarcely second in importance to that of maintaining in healthy vigour the function of digestion. The skin is at once an exhalent of waste matter from the system, a joint regulator with the lungs of the heat of the body, and an agent of absorption amidst surrounding effluvia. Hence the importance of enveloping the body in warm woollen dresses, as practised by the ancient Romans, as the use of flannel next the skin guards against the evils of checked perspiration, regulates the animal temperature in warm climates, and prevents the absorption of deleterious effluvia in malarious countries. The more objectionable parts of the soldier's former dress, his stiff leather stock, heavy shako, and badly constructed knapsack with breast-straps, have been already altered and improved, and every alteration tending to lessen the weight which soldiers are obliged to carry on the march must be received as a boon to them.

Bathing.—External personal cleanliness is in a general way well enforced throughout the army; but the means of general ablution, now beyond the soldier's reach, should be provided for him in every range of barracks of any considerable extent. Warm and tepid bathing is of the first importance, as tending to preserve the healthy functions of the skin, both in tropical and temperate climates. It enables the body to accommodate itself to the changed conditions of new climates, until it becomes acclimated, and impowers the system to resist the morbific influences of malarious agencies generated in hot countries.

Such are the general means—diet, drink, dress, and bathing—for enabling the constitutions of soldiers and seamen to accommodate themselves to changed climatic conditions: and I will now in the *second place* notice the hurtful agencies to which military and naval masses may be exposed, and the best modes of neutralizing them. The most noxious of these agencies are found associated with the sites of barracks, hospitals, huts, and encampments, on shore; or the state of the round houses, sick berths, and hold of ships at sea. But, while each of those individual subjects might claim a lengthened notice, I must now briefly confine my observations to the morbific agencies which render these localities hurtful. Among these are low,

swampy, filthy, confined, ill-ventilated spots, producing malaria; insufficient breathing space in, and defective construction of, barracks, huts, and hospitals.

Barracks.—Medical topography is a most important branch of military hygiene, as it leads us at once to consider the various physical agents which influence the health of the soldier, and to remove him, when practicable, from all causes of endemic disease. In selecting sites for barracks, however, the military capabilities of the locality, rather than its sanitary fitness, have been usually thought of. The opinions of commanding officers, and of the engineer department, have consequently, on such occasions, been more sought for than those of medical officers. But it is the interest and the duty of Government to quarter troops in the most healthy places that can be found, provided always that such selections are compatible with the requirements of the service. Elevation and dryness of locality, free from exposure to strong atmospheric currents from the land or sea, may be looked on as two most important requisites for a barrack or hospital site. In the land service, a large amount of the mortality in the tropical, and even in the temperate zone, may be fairly attributed to the swampy and ill-drained condition of the localities where barracks, hospitals, and military stations have been established. In India I have known a station selected for a regiment of dragoons, where the Government, after going to great expense in constructing barracks, hospitals, and stables, and allowing the regiment to bury twice its average strength in the course of twelve years, ordered the locality to be abandoned and the buildings destroyed. So at sea, much of the sickness that has decimated ships crews in the West and East Indies, and on the shores of Africa, may be accounted for by the miasmatic emanations given off from the accumulated filth of the ship's bottom. Such emanations are doubly vigorous in poisoning the systemic blood, and producing fevers of the most fatal type, when on shipboard the air is imperfectly renewed from above, or in land-locked situations where the atmosphere is stagnant. It is vitally important, therefore, that before any permanent station, hospitals, or barracks for troops be established, measures should be taken for obtaining full topo-

graphical information as to the salubrity of the locality, with the physical qualities of the climate and water; and what influence they usually exert on the health of man and animals.

The ground on which such buildings are placed, whether flat or elevated, should be thoroughly drained. The removal of the surface drainage and animal excreta is more important in the tropical than in the temperate zone; as the decomposition of animal and vegetable organic matter in the soil is rapidly promoted by the influence of high temperature, and becomes a most powerful source of morbific agency. An efficient system of drainage and building is capable of completely altering the unhealthy character of swampy localities: so that Bombay and Demerara, once in as bad repute as the shores of Africa, but now drained and covered with buildings, rank among the healthiest of our tropical colonies.* The beneficial results that have followed from quartering the white troops in Jamaica at Maroon Town and Newcastle, where the ratio of mortality is from 2 to 3 per cent., instead of at Port Antonio, Montego Bay, and Up-Park Camp, where it exceeded 14 per cent., are facts patent to all.

Two of the most important points to be attended to in connection with barracks, hospitals, and huts, are to avoid over-crowding, and to obtain proper ventilation. The first object may be attained by building rooms of a proper size and height, and by allotting them, not according to the superficial extent of the flooring, but according to the cubic contents. Sarlandiere, in his Military Surgeon's Vade Mecum, urges that not less than 1307 cubic feet should be allowed for each man; but we fear that this ample space will never be allowed to soldiers, either in barracks or hospitals. Our prison inspectors allow 1000 cubic feet for each prisoner, and Tredgold on Ventilation deems 600 to be necessary for the preservation of health. The medium of these two quantities, or 800 feet, should be adopted as the minimum for temperate climates, and 1000 for that of tropical ones. A large amount of disease among soldiers is justly

* The unhealthiness of some of the East India barrack sites, as those of Colaba and Secunderabad, from retention of the surface drainage, is well known. But to the credit of the Directors of the East India Company, it must be said that they have ordered all barrack buildings for the future to be raised on arches.

attributable to the continuous breathing of the vitiated atmosphere of over-crowded barracks, hospitals, and huts; and Colonel Tulloch, in his Statistical Reports of the British Army, has shown that crowded barrack rooms, in tropical climates, are not less influential than restriction to salt diet, in producing increased mortality from consumptive diseases.

In regard to ventilation, after all that has been written and recommended by Dr. Reid and others on this subject, the main object to be obtained is a free circulation of air around the building, so that it may be preserved from damp, and be entirely isolated from other buildings.

On the subject of *duties*, *exercise*, *amusements*, and *education*, my remarks must now be very brief; having already occupied so much of your time and patience. Night duty, particularly in tropical climates, should be reduced as much as possible, so that soldiers should have at least four nights in bed; for otherwise, and particularly when they are exposed, even in climates of the temperate zone, to cold and wet in the trenches during a siege, their health will invariably suffer.

Under the head of *exercise* may be included parades, drills, and marches; and no more fertile source of predisposition to disease exists than in the excess of any of these objects,—beyond the physical capabilities of the soldier. Doubtless, long marching in warm climates has been often overdone, so as to render men generally the victims of cholera and tropical fever; and in no part of the military economy of regiments, or armies, may the sound judgment of commanding officers be more usefully displayed, than in the proper regulation of marching or other exercise for the soldiers.

I will not at present enlarge on the amusements, education, and punishment of soldiers; but, in reference to the whole subject, shall conclude by the following medico-military recommendations, promulgated at Burgos, in May, 1823—when the French army was advancing into Spain.

1. The soldiers always to wear their cloth trousers during the prevalence of cold weather.

2. Not to be permitted to undress on arriving at the halting-place, or at their bivouac in the evening.

3. To wear their over-coats whenever the air is chilly, and when they are not on the march or working.

4. In wet weather, to halt for the night on ground a little elevated, sloping, and sheltered from the wind.

5. To increase in such cases the number of fires, and to keep them up till the time of starting.

6. In wet weather to make a distribution of brandy on starting and on arriving at the bivouac.

7. In hot weather, to march the troops early in the morning, or in the evening, resting during the middle of the day in sheltered places.

8. When linen trousers are permitted to be worn, to make the soldier put on a girdle of cloth or woollen stuff round the belly.

9. To make frequent halts, selecting places where the water is good; and to take care that the men do not drink cold water when greatly over-heated.

10. To give them regular exercise when in cantonments.

11. To be careful that their clothes and shoes are kept up and repaired.

12. When compelled to use bad water, to mix a little vinegar or brandy with it.

13. In marshy places, to encamp, if possible, on high ground.

I have thus imperfectly endeavoured to apply the principles and means of medical geography to the preservation of the health and efficiency of our soldiers in foreign climates. But in regard to the removal of men from one climate to another, their regimen, dress, dwellings, and drill-exercises, statistical results are yet to be collected, and made useful, as the foundation of practical deductions, for our future guidance in everything relating to the British army and navy, as well as the East Indian armies.