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Public works DEPARTMENT.

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454-55

Dated 25 1 1871.

Not to be folded or roughly handled

Proceedings of the Madras Government, Public Works Department, 25th January 1871.

No. 454. Read the following letter from the Deputy Secretary to the Government of India, Public Works Department, (Buildings and Roads—Military,) to the Secretaries to the Governments of Madras, Bombay, Bengal, the North-Western Provinces and the Punjab; and the Chief Commissioners of Oudh and the Central Provinces, dated Fort William, 29th December 1870, Nos. 1,431-1,437-B-M:—

I AM directed to forward for information a copy of certain questions regarding sub-soil drainage and other improvements of Indian Stations laid before the Army Sanitary Commission by Dr. Cuningham, Sanitary Commissioner with the Government of India, and of the replies of the Commission thereto.

No. 455. ORDER THEREON, 25th January 1871, No. 225.

MILITARY WORKS, No. 6.

ORDERED to be recorded.

(True Extract.)

(Signed) CHARLES A. ORR, Colonel, R. E.,
Secretary to Government.

Exd. E. C. Shunker.

3A

QUESTIONS regarding Subsoil Drainage and other Improvements of Indian Stations, laid before the Army Sanitary Commission by Dr. Cuningham, Sanitary Commissioner with the Government of India, together with the Replies of Commission.

Introductory Remarks.

Drainage of ground occupied by cantonments involves considerations of health as well as engineering details. Questions of health and points of detail will probably be found to differ somewhat at almost every station, and no general statement can be made on the subject which could be safely followed as a guide under the ever-varying circumstances which present themselves over so great a country as India.

When this subject was formerly under consideration of the Army Sanitary Commission it was, after mature deliberation, decided that the "suggestions" prepared by the Commission, by request of the Secretary of State for India, should be limited simply to an enunciation of general principles of works, and that the application of those principles should be left to the unfettered judgment of the engineering authorities in India, after a careful local inquiry at each individual station which it was proposed to improve.

The views of the Commission on this point are given in the introduction to their "suggestions," and there is nothing in the present questions which should induce the Commission to depart from them.

Any reply now given regarding drainage of Indian stations must be considered as only explanatory of what has been already stated on this matter in the "suggestions;" but as the application of these principles in any special case must necessarily be influenced by the results of local inquiry, it may be advantageous to preface this reply with a few remarks on those sanitary points, which should be ascertained and weighed in regard to all stations which may be proposed to improve, before any works are planned or executed.

Sanitary improvements must necessarily rest for their justification on sanitary requirement, and these requirements can only be ascertained by a careful study of the locality, including the prevailing diseases, and their causes traced backwards to removable local conditions.

The first step in improving any station must, therefore, be to prepare disease and mortality records for British and native troops, prisoners, and civil population, so far as it may be practicable to obtain returns of the last of these.

A careful analysis must then be made of the facts in order to ascertain to what diseases the sick and death rates of the locality are due.

In tropical stations generally the most important diseases are those included under the so-called zymotic class, especially of the miasmatic order.

Much is already known regarding the local favouring conditions of this type of diseases; but in examining Indian stations, some will be found in which the total amount of miasmatic disease is less than in others, and the relative prevalence of single diseases, fevers, cholera, dysentery, &c., will be found to differ at different stations. A careful comparative analysis of local climates, especially as regards daily thermometric range and rainfall, local topographies, and local sanitary conditions of different stations, would no doubt throw much additional light on the whole question of causation, and afford useful data for guiding the sanitary engineer in his work. The relation of distant sources of malaria, often far beyond the boundaries of stations, to the health of troops, and the influence of native populations beyond cantonment boundaries, require very careful consideration in all such local inquiries.

Within the cantonment boundary, and immediately outside it, the points requiring special notice are as follow:—

(*a.*) The geological nature and relations of the surface soil and subsoil.

(*b.*) The condition of surface and subsoils as to permeability to moisture, prevalence of surface fogs, &c., ascertained during dry, moist, and wet seasons, in relation to the prevailing temperatures of the air and earth.

Introductory Remarks.

(*c.*) The chemical constitution of surface and subsoils of stations, with special reference to the amount of water and organised matter they contain. Detailed analysis of soils is almost as important in warm climates as the analysis of waters.

Weighing soils before and after drying will give the proportion of water.

Weighing after drying and again after burning, will give the amount of organic matter sufficiently near for immediate practical purposes.

(*d.*) Analysis of water as now being carried out in India.

(*e.*) The general configuration of the surface and its levels, with reference to corresponding data for the surrounding district, including the question of natural surface drainage and outfall.

(*f.*) The depth of water line from the surface in wells at different seasons, especially during the rains; but this by itself cannot be depended on as showing the water level in the subsoil, unless water had ceased to be drawn for a sufficient time to allow the water level to be restored; because the well is a subsoil drainage outlet, and the level of water in it depends on the amount of water drawn. Trial wells or artesian bores made at different points of the surface, and at different seasons, will enable the subsoil water level to be given with accuracy in plan and section.

The state of river banks and foreshores at different seasons, as to extent of evaporating surface, rise and fall of water level, rise and fall of water level in tanks, jheels, &c.

These elements, when studied with relation to disease and mortality tables, will afford reliable data for discussions on questions of subsoil drainage.

Reports on proposed cantonment improvements should of course include the sanitary state and requirements of adjacent towns and villages, the state of bazars, cleaning, the condition of buildings, barracks, hospitals, quarters, &c., amount and nature of vegetation, influence of ravines, jheels, nullahs, river banks, broken ground, nuisances, &c., on the health of troops and civil population. These points require simply to be alluded to here, as the principles on which they should be dealt with have been already sufficiently indicated in the "suggestions" referred to.

Supposing that a report on any given cantonment is about to be drawn up after sufficient inquiry on the points briefly indicated above, and that the question of subsoil drainage (as one of the questions only) requires to be decided; we should reply to the queries propounded by the Sanitary Commissioner with the Government of India, at least as far as it is possible to do this without specific local examination, as follows:—

Questions respecting the subsoil drainage of cantonments.

Questions.

(*a.*) "In what soils, and

(*b.*) "Under what circumstances is subsoil drainage calculated to improve the health of stations?"

Replies.

Subsoil drainage in climates with excessive rainfall, can never be depended on by itself to remove rainfall. Heavy rains must pass away over the surface, and the first step in freeing the ground of stations, and in their vicinity, from excess of moisture must be by improving surface conduits and valley lines of outfall for this special object. As much of the rainfall as possible should be passed as rapidly as can be out of the station to a safe outfall by well-formed surface drains, and all holes or hollows where water lies after rain should be levelled, filled up, or drained.

When this has been done the question of subsoil drainage becomes narrowed within the limit of freeing the subsoil as quickly as possible from water which has sunk into it, and which cannot by any natural outlet escape with sufficient rapidity or to such a depth below the surface as to prevent the generation of malaria.

We have pointed out in our "suggestions" that it is not so much the amount of rainfall as the hygrometric condition of the subsoil afterwards, which fosters malaria and malarial diseases.

In selecting new stations, those subsoils which trial holes dug in them show to be wet or water-logged even in wet weather, should be avoided. But in existing stations soils of this class should be subsoil drained on the principles laid down in our "suggestions," and without reference to the character of the subsoil.

Lines of drain tiles require to be laid closer in retentive soils than in porous soils. Where alluvial soils are apt to crack during hot dry weather, precautions should be taken to prevent the drainage tiles being injured or displaced by contraction of the soil.

Questions.

Question.

"Is subsoil drainage useful—

"(*a.*) In deep, loose, porous, sandy soils? or,

"(*b.*) Where there is no underlying stratum of clay or other impervious medium?"

Replies.

In loose soils precautions should be taken to prevent the soil passing into the drain tile joints.

The necessity for subsoil drainage in any given case must be determined by the amount of malarial disease and by the hygrometric condition of the subsoil itself, to be ascertained, as already stated, by trial holes at a sufficient number of points, not only during the dry season, but during the rainy season and the period following the rainy season.

It does not follow that a subsoil which is apparently dry on a chance examination during a dry season is a healthy subsoil. The quickness or slowness with which the hygrometric level falls below the surface of the ground is an important element in the question of health.

Subsoil drainage is mainly intended to lower the hygrometric level after rainfall as rapidly as possible, and no soil which does not of itself accomplish this result, with as much facility as drain tiles would lead to it, should be left undrained.

Our answer, then, to the first question must be that the need of subsoil drainage at any given station must be decided irrespective of the geological nature of the subsoil, and that wherever the subsoil does not free itself rapidly from moisture after rainfall there should be subsoil drainage.

Reply.

The reply we have given to the preceding question includes an answer to the present one.

It is not often that towns or stations are built on a perfectly level homogeneous self-draining sand. But if such should be the case, then the reply would be that with proper care and under the topographical conditions supposed, such a subsoil might possibly retain its healthy character (if statistics showed that it was healthy), irrespective of any artificial subsoil drainage.

But if there were irregularities of surface, or slopes, the conditions would be changed, because the rainfall on the higher levels would seek an outlet for itself wherever the outlet was easiest, and it might happen that in a self-draining sandy soil sloping ground and hollows, especially at the lower levels, might give out malaria and cause disease, because the drainage water had accumulated in such situations.

Instances have not been unfrequent where miasmatic diseases have appeared in huts erected on what at first sight was apparently dry self-draining sand, but was found on examination to be damp, for the reasons specified.

The sand on which Aldershot camp is situated has been drained with advantage, and the sand of Aldershot sewage farm has been improved in the same way. The ground in both cases slopes more or less to an outfall, and it was found that subsoil water had a tendency to crop out or lodge at the lower ends of the camp slopes, indicating its presence in the first instance not by apparent excess of dampness, but by the existence of miasmatic disease among the inmates of huts built on the ground, so that additional drainage precautions had to be taken in the locality.

It is highly probable, besides, that the majority of sandy subsoils are not homogeneous. They are frequently interspersed with soils of other kinds. Clays and the like, very thin layers of which would be sufficient to alter the relations of the sand to rainfall, or porous sands may fill up hollows in other retentive strata at a certain depth below the surface. In either case the sand might become charged with moisture drawn up from the hollows by capillary attraction and give off malaria.

Before it can be said that any sandy soil does not require subsoil drainage it would have to be examined with precisely the same care as any other subsoil and with the precautions already mentioned.

If a flat sandy soil were found tolerably free from organic matter, and if the soil discharged itself of superfluous humidity equally all over, and rapidly after rainfall, then the question might be raised as to whether subsoil drainage was necessary in such a case.

Suppose it were decided that the local conditions were so satisfactory that subsoil drainage was not required, we should then have to consider a well known fact with regard to soils of this class, namely, that whether these soils continue to be healthy when occupied by stations or towns, or whether they will eventually become very unhealthy, depends entirely on the manner in which the surface is used.

Sand absorbs sewage and foul water with as much facility as it does pure rain water, or pure river water. This absorbing power of sand has led to

QUESTIONS.

REPLIES.

most serious results to health when feeders have been conducted over its surface for supplying pure water to a town or station from a river or stream, even at a considerable distance. In instances of this kind the first indication of danger in warm climates has generally been, not dampness of subsoil, but severe outbreaks of epidemic diseases. Pure rain water itself will even become foul water before it enters the sand if it falls on refuse filth or other refuse matters left on the surface. Some most severe outbreaks of epidemic disease have taken place in dwellings built on sandy soils, and have been traced directly to the foul state of the surface and subsoil from cesspits or from foul water or sewage draining into these porous soils.

An incidental advantage of subsoil draining sandy soils is that it affords to the rainfall a ready means of washing impurities out of the superficial layers of subsoil, and so tends to diminish malaria.

There is hence a special class of requirements incident to the occupation of sandy subsoils, whether they be subsoil drained or not, which are imperative, namely, that the surface should be kept clean, that there should be no cesspits or self-draining manure heaps, and that provision must be made for the continuous removal to a distance of all impurities, solid and fluid, neither of which should ever be allowed to enter the ground.

QUESTION.

"What are the details of the measures by which subsoil drainage should be carried out?"

REPLY.

The general principles of subsoil drainage in relation to surface drainage works are given in our "suggestions," pages 3 and 4. Further details will be found in a minute on the subject prepared and issued by the General Board of Health, copies of which were sent to India by the Army Sanitary Commission, for the use of the Presidency Sanitary Commissions, a number of years ago. The work of Mr. Parks on land drainage may also be consulted with advantage. The whole subject has been thoroughly discussed, and much experience has been obtained in applying subsoil drainage in different soils. The details are of an ordinary engineering character, and come within the scope of the engineer's duties. Like other engineering details, they would have to be worked out on the spot and under the conditions to which they had to be applied.

QUESTION.

"What extent of ground in the vicinity of the station would it be advisable to embrace in any scheme of subsoil drainage?"

REPLY.

This is a local sanitary question requiring a local answer after a careful inquiry.

The primary object of surface and subsoil draining a cantonment is to remove superfluous moisture from the ground under and in the vicinity of barracks, hospitals, and other buildings, so as to diminish the immediate local ground malaria. And there may be positions where cantonment subsoil drainage would be sufficient for these purposes of health. But it is evident that the most perfect subsoil drainage works carried out within the cantonment boundary will not remove excessive moisture or malaria from broken wet surfaces of ground or from malaria-producing ravines or jheels outside the boundary.

In such cases subsoil drainage outside the cantonment may not always be necessary; levelling and draining the surface may be sufficient.

The effect of ground malaria will diminish with the distance of its source from occupied buildings, other things being equal; but it may still exist, and this to a greater degree, immediately outside a cantonment boundary than within it.

It would not therefore be safe to decide that the subsoil drainage of a cantonment would by itself be sufficient for health without an examination of the vicinity to such distances and in such directions as the configuration of the country may indicate, bearing in mind also that damp or wet ground outside the boundary may be productive of injury to health at a greater distance on the side of a cantonment from which the wind blows during the fever seasons than on other sides. It may be found in such cases that improving watercourses and natural valley lines of outlet, levelling broken ground, filling up pits and holes, and similar improvements in surface drainage, may be sufficient; but there may also be found localities in which the subsoil is more or less wet, and in such cases subsoil drains will be the only means of removing the water, and should be resorted to.

When malaria clearly comes from a distance beyond the immediate vicinity of a cantonment, it would have to be dealt with on other principles.

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In such cases the evil may be diminished by screens of quickly growing bamboos or trees; but the ultimate improvement of extensive districts of this class can only be expected from larger agricultural drainage works and proper culture and cropping.

Cultivation within Cantonments.

"Is it advantageous or otherwise to keep large areas of ground within cantonments denuded of vegetation?

"Would it improve the health of cantonments to encourage vegetation within their limits?

"If so, to what extent, and of what kind of culture?"

It will be better to deal with these questions together, because they all refer to the same point, namely, the influence of culture on health.

It may be safely stated as a general answer to the questions that wherever in a hot climate there is moisture sufficient to sustain vegetation in any subsoil near human dwellings, the ground had better be cropped; and wherever from peculiar local circumstances such ground does not admit of being cropped, the healthiness of the locality can be improved by subsoil drainage of the ground.

There are many localities, however, in India as elsewhere, in which no amount of culture will by itself absorb the subsoil moisture to a sufficient depth to keep ground in a healthy condition. In these instances drainage and agriculture must go together.

As a general rule subsoil drainage improves the healthiness of a subsoil not only by withdrawing moisture but by admitting air into the body of the soil, and so increasing its productive power.

Vegetation promotes dryness by increase of evaporation. It has been calculated that 200 lbs. of water are evaporated to grow one pound of woody fibre either in timber or grass. Vigorous growth on drained or cultivated ground, if so conducted as not to interfere with ventilation, purifies the atmosphere, as well as the subsoil.

It follows from what has been said that subsoil drainage with cropping would be beneficial to the health of most stations.

This must, however, be taken merely as a general statement, because it is quite possible to use ground for crops in such a way as to do harm rather than good, and this risk might be incurred at any Indian station if the culture of ground within or near its limits involved as one of its conditions the locating of a population of native cultivators on the land, and this on account of their filthy habits, or if the culture itself were of an unhealthy character.

The best and safest covering for bare ground near dwellings is grass or some similar crop wherever it will grow.

Vegetables to be used by troops would also be advantageous.

Tall vegetation affording facilities for committing nuisance should be avoided.

Wet culture, that is, culture requiring the ground to be flooded or kept constantly wet, should also be avoided, because wet culture brings on the ground an excess of the very element, namely, water, which it is desirable to remove.

Cultivation would have to be properly regulated as to times and seasons in cases where much movement of earth was necessary.*

Trees properly trained so as to afford shade without interfering with ventilation can be grown with advantage.

In any case provision should be made for the immediate removal to a distance or for burning of all dead vegetation.

The extent to which culture can be introduced into cantonments will depend on the amount of disposable ground not required for parades and other purposes. If culture be introduced at all, there is no reason why the extent should have any limit except that of the area disposable for the purpose.

The entire success or failure of culture as influencing the sanitary condition of a cantonment will depend on the care and system with which it is carried out. It had better never be tried if after having been carefully introduced it is allowed to fall into neglect.

The cultivation of a cantonment should be made ornamental as well as useful, and should be kept so.

* The following Algerian experience suggests useful precautions in clearing and cultivating ground in hot climates:—

"The older colonists agreed that although the first work of clearance and cultivation is invariably attended by fever, much of this sickness could be avoided by selecting the proper period for clearing and draining, namely, the colder season, leaving the land to be baked during the summer heats previous to actual cultivation, and by sanitary precautions. These consist in avoiding commencing work till the sun has risen, the use of generous diet, careful selection of drinking water, good clothing, ablution and change of clothing after work, not living in close vicinity to the work itself, and frequent use of coffee. With these precautions they asserted that the clearance of waste land and bringing it under cultivation, was not attended with serious risk to health."—(Report on the causes of reduced mortality in the French Army serving in Algeria, p. 20.)

Replies.

Question.

"Would irrigation by sewage of cultivated ground within cantonments be advisable?"

Reply.

The subject of sewage irrigation as applicable for the disposal of barrack sewage was considered by the Commission some years ago, and in the absence of knowledge of local conditions, it was proposed as a general principal that no land should be irrigated within 500 yards of barrack buildings. But the distance in any given case would have to be decided with reference to prevailing winds, to the quantity of sewage, and to the nature of the soil. In hot climates the distance, under corresponding conditions, would probably have to be greater than in cold climates.

Much additional experience has been recently obtained, tending to show that sewage irrigation, if carefully applied, is a perfectly safe expedient. The sewage farm at Aldershot is about 80 acres in area, and in summer receives the sewage of 12,000 people and 2,286 horses. It lies to leeward of the North Camp, and its edge is 500 yards from the Camp. Occasionally, when the wind blows over the farm towards the Camp, a slight odour is experienced. But the Camp is remarkably healthy. There are a number of instances in England of sewage irrigation from towns and large establishments carried out within 200 or 300 yards of dwellings without appreciable nuisance.

There has as yet been no instance of injury to health from sewage irrigation. One of the healthiest barracks in the United Kingdom is Piershill, immediately outside the walls of which lie the old extensive irrigated meadows receiving the sewage of Edinburgh. Complaints have been made of nuisance from careless application of sewage, but not to any great extent. Living plants are the best "disinfectants" and "deodorizers."

The Madras sewage farm will very shortly afford all the experience required in dealing with the question in India, and it would be better to watch its results before arriving at a decision.

Question.

"Would the use of manure from latrines on such lands, if carefully carried out, be attended with any danger?"

Reply.

The reply to this question must be similar to the one given respecting sewage irrigation.

Latrine matter can be safely used for manure if it be put into the ground in proper proportion and at a sufficient distance from buildings to avoid nuisance during warm, moist, or rainy weather, and if the ground be cropped at the same time.

There should be no such a thing allowed as burying latrine manure in masses; the proportion of manure applied should be adjusted to the amount of earth and to the requirements of the crop.

The same rules as to direction of prevailing winds, the amount of manure used, the nature of the soil, and the distance from buildings, are applicable in this instance as in sewage irrigation.

It is very probable that at many stations the use of latrine manure would necessitate the application of water to the crops, and this circumstance would bring the application of latrine manure under the same conditions and precautions as those necessary for sewage irrigation.

The safest and cheapest way of applying manure to land is however in the form of sewage. Manured or sewaged land should be subsoil drained.

As the dry earth system of conservancy has been largely introduced into India, it may be useful to give the comparative value of ordinary town sewage in England where watercloset are in use, and its value where watercloset refuse is excluded from the sewers and separately removed from houses.

The facts are stated in the Report of the Royal Commissioners (Sir William Denison, Dr. Frankland, and Mr. J. C. Morton), on the Pollution of Rivers, vol. 1. The following are the averages:—

Composition of Sewage in Parts per 100,000.

	Total solid matters in solution.	Organic carbon.	Organic nitrogen.	Ammonia.	Nitrogen as nitrites and nitrates.	Total combined nitrogen.	Chlorine.	Suspended matters.		
								Mineral.	Organic.	Total.
37 midden towns	82·4	4·181	1·975	5·435	0	6·451	11·54	17·81	21·30	39·11
50 watercloset towns.	72·2	4·696	2·205	6·703	·003	7·728	10·66	24·18	20·51	44·69

Questions.

"Where native towns are situated so near cantonments as to prejudice the health of troops, what special measures can practically be taken in regard to these towns, it being borne in mind that there are great difficulties in dealing with native towns which do not exist in cantonments?"

Replies.

The Commissioners continue:—"These analytical numbers show a "remarkable similarity of composition between the sewage of midden "towns and that of watercloset towns." "For agricultural purposes 10 "tons of average watercloset sewage may in round numbers be taken to "be equal to 12 tons of average privy sewage." The average quantity of chlorine in 100,000 parts of watercloset sewage is 10·66, while in midden-towns' sewage it is 11·54, indicating the proportion of urine in the sewage, and the influence of the additional water in watercloset towns in diluting it. "The retention of the solid excrements in the "middens is not therefore attended with any considerable diminution in "the strength of the sewage." "Neither is the case substantially different "where earthclosets are substituted for Lancashire middens, for the sewage "from Broadmoor Lunatic Asylum, in which these closets are partially "used, exhibits no exceptional degree of weakness."

These facts, resting on a firm scientific basis, have an important bearing, not only on the question of sewage irrigation, but on the question of station drainage in India.

We showed this in our minute on "the dry earth system of sewage" (March 8th, 1869); and the Royal Commissioners arrive at a similar conclusion in stating that "it seems hopeless, therefore, to anticipate any sub-"stantial reduction of sewage pollution by dealing with solid excrementi-"tious matters only." It follows that to trust to dry earth conservancy for improving the health of towns, while ordinary station or town drainage is permitted to soak away in cesspits or on the surface is simply to poison the subsoil with sewer water, which if collected and conveyed in drain pipes would become a valuable manure. The question may now be considered as settled by scientific investigation, that the sewage of inhabited buildings should be treated as a single element, whether as regards health or agriculture, and also that to divide this sewage into two parts, and to remove the parts separately is, as we have stated elsewhere, to pay double where one payment would answer every purpose.

Question.

"Where native towns are situated so near cantonments as to prejudice the health of troops, what special measures can practically be taken in regard to these towns, it being borne in mind that there are great difficulties in dealing with native towns which do not exist in cantonments?"

Reply.

The causes of unhealthiness of native towns and the general principles of improvement applicable to them have been already discussed in our "suggestions," but since these were prepared some experience has been obtained in India, especially at Calcutta and Bombay. The procedure at the last-mentioned city appears to have been efficient, if we can judge by its influence on health.

The present question refers not so much to the permanent improvement of native cities and towns as to diminishing the injury caused by them to the health of troops near them, by the adoption of temporary expedients until permanent improvements are carried out.

The reply must therefore be limited to the terms of the question.

No man ought to be permitted in India, any more than he is permitted in England, to use his property or rights in such a way as to injure his neighbour. This is a fundamental principle in the question, and it follows from it that no man can sustain a right to keep a dunghill or a cesspit within his premises, if, by doing so, he injures any one else; and no man has a right to create a nuisance to the detriment of his neighbour.

Further, it is an admitted principle in British sanitary legislation that a man who creates a nuisance must either abate it himself, or the community must compel him directly or indirectly to abate it.

It appears that at some stations nuisance is experienced from wind passing over native towns near barracks. There is also evidence that injury to health and life arises from this, especially during epidemic seasons.

The chief sources of danger in Indian towns and villages appear to be the state of road surfaces and of the surface drainage, filthy dwellings and compounds, dungheaps, cesspits, filthy native habits, and, indirectly, impure water, predisposing the people to epidemic attacks near troops.

Bombay experience has shown that it is perfectly possible to deal with these sources of ill health successfully by sanitary police regulations diligently enforced; that people will even improve the surface drainage themselves or have it done at their own cost; that they will submit to be kept clean and pay for it; and that there is little difficulty in inducing them to conform to sanitary precautions if their object be explained,

QUESTIONS.

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and strict supervision kept up to see that the regulations are carried out. As the final object is to induce the people to attend to their own health and habits, every effort should be made to enlist the feelings of the people on the side of improvement.

Bearing this Bombay experience in mind, the only reply we can give is that indicated above, namely, that all native towns, villages, and bazars near cantonments should be brought under the operation of a rigid cleansing police; that the surface drainage should be improved, the outskirts of towns, villages, and cantonments to a sufficient distance protected from nuisance, and that wells belonging to towns, villages, and bazars should be cleansed, the water supply examined, improved and protected from sources of impurity, or new wells dug where existing wells are irremediably impure.

There is every probability that if these precautions were rigidly enforced in native towns and villages much of the ill health, especially from epidemic diseases, would be removed, both as regards the people themselves and the troops in their vicinity, without the execution of any costly works, although there would be scope after all was done for the introduction of sanitary works, but in most instances these works would be more beneficial to the health of towns themselves, than to the health of cantonments at a distance. There appears to be no reason why the labour for simple sanitary improvements should not be supplied by the people themselves with such assistance as may be necessary.

A few instances of thoroughly improved native towns and villages would do more to enlighten the people on their true interests in this matter than anything else.

Water Supply.

QUESTION.

"Any recent information in regard to sources, works, &c., including the smallest amount of water per head which should be sufficient to remove barrack impurities by means of pipes, together with means of economising water, it being borne in mind that as regards the case of nearly all Indian cantonments there are no existing sources which form natural head works?"

REPLY.

The most recent information regarding Bengal water sources is that afforded by Dr. Macnamara's Reports.

The results may be stated generally as follow:—

1. That with the exception of a few wells loaded with saline impurities derived from the soil, Bengal waters are not generally hard waters, and naturally they are good and wholesome in quality.

2. That nevertheless the majority of water sources are more or less polluted by organic and saline matters not due to the sources, but proceeding from the following preventible causes.

(*a.*) Polluted subsoil drainage finding access to wells, from fouling subsoils of stations and towns where wells have been made by sewage and other decomposing matters, cesspits, filthy habits, and the like.

(*b.*) Bad methods of drawing and distributing water. Slopping the surface round the well's mouth, and passage of foul water back into the well. Careless and filthy habits of water-drawers using dirty cords and dirty vessels; water slopped over their feet falling back into wells.

(*c.*) Want of protection round and over the mouths of wells, whereby filth, decaying substances, and other impurities obtain access to the water.

(*d.*) Suicides and accidental drownings from the same cause. All the drownings in Bombay presidency in 1868, amounting to 1,608, took place in water sources. Of this number there were 1,101 deaths from accidents and suicides in wells.

(*e.*) Carrying, drinking, and cooking water in skins scarcely ever cleaned, and often used for carrying water of bad quality.

3. From these circumstances it follows that well waters are of uncertain constitution, and that so long as the existing sources are left without protection, and are exposed to any risks that may arise from additional subsoil impurity or from careless native habits in drawing and carrying water, so long will the health of persons using the water be exposed to preventible risks.

As regards quantity, the Commission has already stated that no more water is required for the purpose of keeping drains clear than is required for the domestic consumption of the population using the drains; in other words, sewers and drains are simply intended to remove water brought into a station or town for domestic use in an economical and continuous manner, and they are not intended to make any special demand on the water supply for the mere purpose of keeping them free of deposit.

The only question therefore is the quantity of water required for domestic use.

We have already estimated this for Indian stations at about 12 gallons per head for barracks, and 30 to 35 gallons a head for hospitals per diem; of

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this 2½ or 3 gallons per head would be required for waterclosets or latrines, and this amount would have to be deducted if the dry-earth system of conservancy or any similar system of dealing with latrines were adopted.

Under certain circumstances it might economise water to use bath water for latrines.

It is evident from the local topography of many Indian stations that such a water supply as is here stated must be pumped up either from rivers or from deep wells.

India itself has recent examples of several methods of supplying water continuously.

Bombay water is provided by head pressure.

Madras will be supplied more or less on this principle.

Calcutta receives its water from the Hoogly and filters it.

Deep wells dug in porous strata near rivers, and tunnels carried in porous strata under rivers, have been used in Europe as water sources from which water is raised to a head by pumping.

Water from deep wells dug in any water-bearing strata yielding pure water can be raised by pumping to a sufficient head by stand pipes or water towers. The greater part of the vast population of the metropolis is supplied with water pumped partly from rivers, and a small portion from wells.

The general principles of water supply of Indian stations have been already discussed in our "suggestions," which contain all the points required for dealing with the engineering aspects of the question.

In draining buildings at very flat stations it is well to provide means of flushing main lines of drainage independently of the action of the flow, but this can be done without additional water by using a small portable tank filled with bath water, and discharging its contents suddenly into the head of the drain.

Various forms of water tap have been used for economising water, but in practice the least liable to wear and accident is an ordinary watercock with a weighted handle which allows water to escape only when it is held up, and stops the escape by simply being let go.

The Commission would repeat here that, as far as has yet come to their knowledge, there is nothing to prevent any military station in India being supplied with water sufficient for all purposes by simple methods long tried by experience and familiar to engineers who have been engaged in British town improvements.

It may be safely stated also that no population which has once obtained the benefit of a water supply would ever voluntarily revert to the methods at present in use in India; whatever the difference of cost might be; if indeed the difference be not always in favour of supplying water by engineering works. The following data given long ago in our "suggestions" illustrate the question of expense:—

"A steam engine working with coals at 20*s.* per ton will raise 90,000 "gallons of water (900,000 lbs. or upwards, or 400 tons weight) 100 feet "high, at a working cost of one shilling. One man making six journeys "per hour with two gallons or 20 lbs. weight, and working at this rate "eight hours, would carry up to an elevation of 100 feet, 96 gallons "of water, or 960 lbs.; so that it would require the united labour of "upwards of 900 men working eight hours to perform 1*s.* worth of "steam-engine work, such as is daily performed at the large waterworks "pumping establishments for London." Small steam engines would not be so economical, but they would be far cheaper than manual labour.

Barracks at Hill Stations.

QUESTION.

"What would be the best style of barrack for hill stations, with due regard to elevation and climate?

"What amount of superficial area and cubic space per man would be sufficient at hill stations?

"Might the present allowance of 77 square feet be reduced without ill effects?"

REPLY.

The answer to these questions would probably differ somewhat at every hill station. Everything depends on the local climate, elevation, exposure, and locality.

If any hill climate closely resembled those of British home stations, the amount of surface area need not exceed the home allowance, viz., 60 feet. In any semi-tropical climates, such as those at Malta or Gibraltar, the superficial area should not be less than from 70 to 75 feet per bed. This being decided, the cubic space would depend on the height of the room required for comfort at any given station, and this element may safely be left to adjust itself from experience already obtained in dwelling houses on the hills.

There are certain principles of construction applicable wherever a number of people occupy the same room, which should be observed in these hill barracks as well as in those of similar climates.

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1. There should be windows on opposite sides of the room.
2. Each room should have a fire-place (a drawing of a warm fresh air grate for burning wood is given in our "suggestions").
3. The size of the room will have to be to some extent determined by principles of economy as applied to the possibilities of sites available.
4. It is best wherever practicable to place barrack and hospital buildings on levelled ridges.
5. If sites must be selected on slopes, barrack and hospital blocks must always be placed with their ends, never with their sides, to the slope. To do the latter is to endanger outbreaks of epidemic disease among the troops Sloping ground can be dealt with in one of two ways:—

(*a.*) It may be terraced so as to enable one end of the barrack room to be projected away from the slope, leaving a distance of 20 feet between the section of the slope and the end of the room nearest it. And care should be taken to cut off by drains all water descending to the terrace from the higher ground.

(*b.*) A platform supported on pillars may be raised on the slope and the barrack block constructed on it.

Verandahs and jalousies should be provided to protect the walls from excessive sun radiation, and the roofs should be made heat and cold proof, but thoroughly ventilated.

We have elsewhere stated that in healthy hill climates barracks may be built with two floors of sleeping rooms.

Hospital Accommodation for Native Troops.

QUESTION.

"What amount of cubic space and superficial area should be given in hospitals for native troops?"

REPLY.

The principle laid down by the Commission in respect to native troops in their own country is that the amount of space and area should be the same as that allowed to British soldiers at home stations.

From 90 to 95 square feet per bed in these hospitals is considered sufficient, and the cubic space per bed would depend on the height of the wards. When a hospital is constructed of small wards, each in a separate building like a hut, a smaller amount of space and area will suffice for health than in a large hospital building containing a number of wards. Local native customs in regard to healthy dwellings will sometimes afford useful indications in providing native troops with both barracks and hospitals.

Sanitary Apparatus.

QUESTION.

"Would it not be desirable to send to India a collection of specimens of sanitary apparatus?"

REPLY.

It would be very important to do so. There should be a collection kept for reference at the capital of each Presidency, showing the various kinds and sizes of agricultural tile-drains, drain-pipes, lavatory and bath apparatus, cooking apparatus, urinals, latrines, waterclosets, sinks, water-pipes, cocks, hydrants, filters, manhole-frames and covers, side-entrance frames and covers, sewer-flushing apparatus, &c. More practical information would be obtained by an inspection of apparatus of this class than from either descriptions or drawings.

Statistics.

QUESTION.

"Would it not be advisable to make arrangements whereby the movement of disease and mortality in India, especially from epidemics, should be concentrated for the information of the Government of India?"

REPLY.

It is necessary for the purposes of efficient control and to ensure correctness that each presidency or government should obtain, classify, and publish its own statistics in the manner now carried out in the three divisions of the United Kingdom and in the British colonies.

This is the only way in which efficiency can be obtained. But it is attended with some disadvantage, inasmuch as there is no common centre to which all the statistics can be transmitted, and comparisons made for public purposes; so that the movement of disease over the vast area of Her Majesty's dominions is never accurately known. This kind of knowledge is especially necessary in India, because although epidemics generally follow the same course in each division to the country, these destructive diseases may move in subservience to a common law, which it is of great importance to arrive at. At the present moment the want of correct information in regard to the movement of cholera in India is greatly felt, and the instructions issued by the Commission for conducting the inquiry now going on into this disease, take for granted that the facts of movement can be ascertained and rendered available for constant use by the Government of India.

This information could be obtained, however, without interfering with the local machinery by which statistics are collected. We consider it very

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desirable that the Supreme Government should be kept constantly informed as to the places, dates of appearance, and movements of all epidemic diseases, especially of cholera, throughout the entire extent of India.

We have stated in the instructions the statistical points of most importance as regards troops, prisoners, and civil population, and we have no doubt that arrangements could be made for the transmission of this information from all points of the country through such channels and at such times as the Government may consider suitable, and for its frequent publication.

QUESTION.

"Has the Commission any special suggestion to make regarding measures to be taken when stations are invaded or threatened with cholera, or regarding the evacuation of the affected places?"

REPLY.

The Commission has had this subject recently under consideration with reference to Dr. Murray's report on the treatment of cholera, and their views, as deduced from the most recent experience of 500 medical officers in India on this subject, given by Dr. Murray, are embodied in a special minute already sent to the Secretary of State for War and the Secretary of State for India.

Regimental Arrangements.

The questions under this head were considered by the Royal Commission on the Sanitary State of the Indian Army, and answers were given on the general principles involved in the questions. The Commission have, however, considered it advisable to communicate with the Director-General of the Army Medical Department, and he has been good enough to place at their disposal the latest information and experience on the subject.* It will be seen that the evidence on which the Royal Sanitary Commission reported has been confirmed by subsequent experience, and that all the facts point in the same direction.

QUESTION.

"What should be the composition of regiments sent to India, to avoid the losses consequent on allowing unsuitable men to go there?"

REPLY.

To this question the Royal Commission on the Sanitary State of the Indian Army gave the following reply (8vo Report, p. 126):—

"That no recruit be sent to India under 21 years of age, nor until he has completed his drill at home, and that recruits be sent direct from home to India so as to land there early in November."

This recommendation does not appear to have been carried into effect.

Reports from medical officers of the highest rank and experience in India still point out too early service in India as a powerful predisposing cause of disease.

Inspector-General Dr. Muir states that one pregnant cause of the high rates of sickness and mortality among the European troops in India is the large number of boys and growing lads who are sent out.

The following table gives the facts for four regiments lately sent out.

Regiments.	Number under 20 years of Age.	Number of Recruits not yet discharged drill.
92nd	239	116
1/6th	165	13
85th	155	96
2/60th	163	9

The last two regiments were quartered at Calcutta and Meean Meer, both peculiarly malarious localities.

Inspector-General Dr. Beatson has expressed a similar opinion as the result of his Indian experience. It is true that statistics show a less mortality at the younger ages of soldiers; but this is only an apparent advantage on the side of youth, as it resolves itself simply into a clear statement that the longer the residence in India the greater the mortality. To make age a test of mortality, the men of the different ages contrasted should have served the same time in India. But the experience of medical officers is, that sending unformed soldiers to India is one potent cause not of high death rates in the year or two after their arrival, but of a higher death and inefficiency rate in subsequent years, from the resisting power of their constitutions having been unduly weakened during the first year or two of immature service.

* See Appendix.

Questions.	Replies.
	The Director-General informs us that he has received lately numerous reports deprecating sending young and delicate soldiers to India. The 92nd Highlanders suffered from typhoid fever soon after reaching India. This disease prevailed chiefly among the youths, who, as the preceding table shows, were in large proportion in the regiment. To this fact Deputy Inspector-General Monro attributes much of the prevalence of the disease. Immature men of the 21st Fusiliers were the chief sufferers from malarial fever at Kurrachee, and on unformed constitutions in the 62nd regiment at Lucknow fell a large proportion of sickness, including cholera. Many other instances might be adduced of similar results, but the fact is well known. French experience in Algeria is to the effect that a soldier stands the conditions of service in that country with least damage at the age of 25. (Report on the causes of reduced mortality in the French Army serving in Algeria, p. 34.) On considering the question in light of most recent experience, the Commission adhere to the recommendations of the Royal Commission on the Sanitary State of the Indian Army quoted above.
Question. "What arrangements could be made to ensure the arrival of troops in India at the proper season?"	Reply. The terms of the question are such as to render a direct reply very difficult. There is no difference of opinion on the propriety of landing troops in India within the last two months of the year. To land them later, especially for service on the plains, is to incur a certain risk to health and life, which might be avoided if they were landed in November or December. But when a large force has to be collected, conveyed by sea, and distributed over so great a country as India within so short a time, and when this process has to be continued year after year, it is evident that a larger cost must be incurred than would be necessary if time was not an object. It is a question of cost of efficiency against cost of transport. But it is part also of a larger question, namely, the rotation of stations. The general principle for adoption would apparently be to send out the troops for the most distant and least accessible stations first, and to locate those arriving latest at healthier stations, most easily accessible from the port of disembarkation. It is a well recognised fact that regiments suffer more the first year after arrival in India than subsequently, unless in the case of an epidemic invasion. Instances to the contrary, no doubt, may be found, but it is a fact, nevertheless. If as many of the most unhealthy stations as possible were abandoned, and if all troops on arrival were sent direct to hill stations, the time of landing would matter less than at present, because at whatever time troops might reach India they would, with improved means of communication, be within easy distance of healthy climates.
Question. "Also the departure of invalids from India so as to ensure their arrival at the proper season in England, and their selection at the most favourable time in India. The present system is faulty on both heads?"	Reply. Everything connected with the movement of men in India has undergone such changes of recent years that the present times of invaliding might be rearranged with great advantage. From information placed by the Director-General at the disposal of the Commission, especially from statements made by Inspector-General Beatson, Principal Medical Officer at Netley, it appears:— That many men arrive at Netley as invalids who ought never to have left India. This occurrence is attributed to the fact that men who have been worn down by the heat of summer look so ill at the end of the hot season as to justify the belief that they really require a change; whereas many of them during the cold season would be so much improved as to be scarcely recognised at its termination. It is hence considered that the invaliding Boards should sit at the end or beginning of the year instead of in October, the present time for these Boards, which was fixed when the means of locomotion in India were widely different from what they are now. Another great evil arising from the existing invaliding arrangements is that men whose constitutions are shattered or who are labouring under organic diseases are embarked at such times as to arrive in the cold weather in England, to the imminent danger of health and life. The "Crocodile" arrived on the 12th January last with invalids from India. There was a great mortality from pneumonia among them on the passage home, and after the men arrived in England. This was directly the result of too rapid change of climate.

Questions.	Replies.
	It is simply repeating a well-known fact to state that one of the most dangerous experiments which an invalid with chronic disease or diseased susceptibility of chest or abdominal organs can make, is that of coming from a warm climate into an English winter or cold spring. Any man who can stand such a change without injury is scarcely an invalid. The Commission would recommend for consideration that invalids should be passed at such times as would enable them, after receiving their papers and reaching the port of embarkation, to go on board so as to arrive in England not earlier than April. They would further recommend that medical officers should be required to certify whether particular cases should not be transferred to the hospital at Suez, which should be utilised as far as its limited accommodation (40 beds) permits, and detained there so as to enable them to reach England at a later date during the summer weather. As it appears from the facts laid before the Commission that preventible suffering and risk have been incurred by invalids from want of clothing suitable for the rapid changes of temperature while proceeding northwards, the Commission would recommend the issue of additional articles of clothing being made at Suez.
Question. "As no general plan at present exists for locating troops at suitable stations on their first arrival in India, and for a tour of duty thereafter, so as to render their service in the country as little hurtful to health as practicable: — Would it not be advisable specially to consider the subject, and to lay down some special practical plan, to be carried out so far as the exigencies of the service admit of?"	Reply. The Royal Commission on the Sanitary State of the Indian Army, after fully considering this subject, arrived at the following general conclusions as to what ought to be the basis of improved conditions of service in India (8vo Report, page 114):— "1. To reduce to a minimum the strategic points on the alluvial plains, and to hold in force as few unhealthy stations as possible. "2. To locate a third part of the force required to hold these points on the nearest convenient hill station or elevated plain. "3. Never to trust to simple elevation as a means of protecting health, but while occupying the best available elevated stations, to place these (for they want it just as much as stations on the plains) in the very best sanitary condition." It will be seen that the occupation of hill stations by a third of the force was considered by the Royal Commission as the fundamental condition of improvement. Sir W. Mansfield, in a recent speech at the delivery of the annual Budget, is said to have referred to the location of troops, and stated that it was with great satisfaction he had been able to urge on the completion of the hill military stations at Chukrata and Raneekhet. The mortality in hill stations was insignificant compared with that in other parts of India, and he thought that arrangements should be made for the location of three more British regiments at hill stations, so that one-fourth of the entire British force might be always stationed in the Himalayas. There were great military reserves, and advantages now existing in the country, such as facilities of communication by which armies could be brought together in the least possible time, which were altogether unknown to their predecessors. Information supplied to the Commission by the Director-General shows that experience obtained since the date of the Royal Commission Report is altogether to the same purport.* The following is the ordinary routine of movement:— A regiment arrives at Calcutta from England, and is sent to an up-country station, and thence moves onwards to Peshawur, thence to Central India or to Bengal. If the regiment arrives at Bombay, it is sent to the Punjaub, moves eventually to Peshawur, thence to the North-West or to Oudh, and perhaps to a hill station, and thence to Central India. The Commission can of course only look on the effects this method of proceeding is likely to have on the health of regiments. It is an axiom that no regiment which has suffered from malarial disease at a malarial station ought to be moved into another malarial station, still less into a station more unhealthy than the one it has been suffering before removal. It has unfortunately happened that the most malarial station in India, Peshawur, lies in the tour of duty of corps proceeding from other malarial stations, and this no doubt has been one cause of the excessive losses of regiments in the Peshawur valley.

* Vide Appendix.

QUESTIONS.

REPLIES.

There appears to be no regular tour to hill stations, and neither recruits nor newly arrived regiments are sent there.

Within the last few years some regiments have been twice at hill stations; one has been three times, others not at all.

The difficulties of introducing a regular rotation of stations, including hill stations, are not to be underrated. They are no doubt considerable, but with the experience obtained in India of late years they ought not to be insurmountable. As to the necessity of some improved arrangements of stations there can be no doubt.

The utilisation of hill stations to the largest extent being recognised as a prime necessity for the maintenance of the health of European soldiers in India, it is urged that some system to obtain this should be instituted. The evidence submitted to us goes to establish the fact, heretofore very generally admitted, that the real value of the mountain regions of India is in preserving health, and that their curative powers are comparatively small, especially to the subjects of organic disease.

Were this knowledge acted upon, it would follow that the present barracks for convalescent depôts in the hills might be chiefly used for regiments or wings of regiments, or newly arrived drafts: additions might readily be made to some of them for this purpose. Were the period for invaliding changed from October to January it might nearly always be determined what men would be likely to recover by remaining in the plains or by removal to the hills, and whom it would be advisable to send home; and were the principle recognised that sufferers from organic disease of any importance, and those whose constitutions had been seriously impaired, should be invalided to England instead of to the hills, the requirement of the latter as resorts for invalids would be greatly diminished.

The Commission are of opinion that for purposes of health regiments on first arrival in India should be sent to the hills to spend their two first years' service there, and that the hill stations should be of sufficient number and capacity to accommodate one-third of the European force serving in India, by which every regiment should serve two years in the hills for every four in the plains. It is not intended that men should be kept idle. Evidence has been produced showing clearly the remarkable degree of health enjoyed by working parties, employed chiefly on road making in the mountains. Wherefore it is believed that additions to present barracks, and even new ones, might be mainly made by the men themselves with great advantage to their health, and this occupation would not interfere with their military employment during the winter. Every hill station might, in addition to accommodation for a regiment, provide for 150 invalids.

Invaliding sufferers from organic disease to England in the first instance, instead of sending them to gain but little in the hills, prior in so many cases to final removal to England, together with the proposed rotation system of all regiments to the hills, would render such provision for weakly men sufficient, and obviate the expense of separate establishments.

The Commission do not fail to recognise a difficulty regarding this provision for drafts on arrival from England, but would suggest as far as practicable the same principle being adopted as for regiments on first arrival in the country.

QUESTION.

"Should not arrangements be made for sending sickly men at once to the hills during the hot and rainy seasons?"

REPLY.

The Royal Sanitary Commission's Report very wisely remarks:—"As regards disease, the mountains of India are but partially curative." Moreover, it is more than doubtful that a move from a distance to the hills, even by rail, in the hot weather, would benefit a man seriously ill. Such moves should be undertaken with extreme caution. A sudden change to the cold and damp of the hills of a sufferer from acute or sub-acute disease of the liver or bowels would be a hazardous procedure; whether justifiable in individual cases it is difficult to say, but as a general practice it does not seem a safe expedient.

Sufferers from certain forms of disease at stations close to the hills might no doubt often be removed to the hills with advantage.

Scientific Inquiry into Cholera.

QUESTION.

"With reference to the scientific branch of the cholera inquiry in India, would it not be desirable to supplement the instructions drawn up by the Army Sanitary Commission by a few suggestions as to the best method of conducting and carrying out the inquiry? And would it not be important to connect Drs. Lewis and Cunningham, either directly or indirectly, with the Home Authorities, so that any difficulties occuring in the course of their investigation might be promptly met, and scientific details communicated early?"

REPLY.

The Commission in their instructions for the Indian cholera inquiry, and in the accompanying memorandum, expressed their opinion that the details of the inquiry should be left to the authorities in India. They merely stated generally in what manner the reports should be transmitted from observers in India to the Indian Government, and thence to the India Office at home.

QUESTIONS.

REPLIES.

The present question refers specially to the scientific portion of the investigation, and the manner of reporting and checking the results.

While giving the following reply to the points in the question, the Commission must be understood as abstaining from all dictation in the matter. Their object is simply to afford to the authorities in India the means of arriving at such an arrangement regarding the work as may facilitate its execution.

Section No. VI. of the instructions (special local inquiry) is subdivided under the following heads:—

1. Microscopic examination of the external atmosphere.
2. Examination of soils.
3. Microscopic examination of water.
4. Microscopic examination of articles of food.
5. Microscopic examination into the pathology of cholera.
6. Microscopic and physiological inquiry into the cause of cholera.

Each of these heads contains two distinct sets of investigations intended to check each other. One has reference to the normal condition of the objects submitted to examination at times and places where cholera is absent, and the other at times and places where cholera is present in varying degrees of intensity.

To conduct inquiries on these points necessitates an organised direction and procedure. They would be very inefficiently carried out unless some general plan were laid down and acted on. One of the objects in sending two trained officers to India for the purposes of the investigation was, that instead of trusting to desultory observations made by medical officers, most of whose time is already more or less occupied with other work, two specially trained observers kept constantly on this service would acquire increasing facility and experience in dealing with its objects, so that in due time all the light which modern scientific methods could throw on the subjects of investigation might be obtained and rendered available for public purposes.

The whole inquiry is so framed that theory or hypothesis are no parts of it. There is nothing wanted from it at present but carefully observed facts, in the hope that these facts will in time range themselves under general laws indicating the means of saving life.

With this view each section of the inquiry throughout the instructions contains points depending for their elucidation more or less on the scientific data to be acquired under Sections VI. and VII. The questions are so arranged that the replies will check each other, so that fresh investigations may be directed to clear up any doubtful points when requisite.

The fundamental condition therefore of the entire procedure is that the instructions should be taken as a whole and complied with as far as practicable.

Copies of them should be put into the hands of every officer engaged in any branch of the inquiry, with a request that in replying to, or giving information on any question or questions, he should attend to the precautions indicated for avoiding errors in observation, and reply as closely as possible in the terms of the questions. Facts may present themselves, regarding which, other and more special questions may have to be asked, but such questions will suggest themselves when the occasion arises.

The Commission, considering it of great importance that some arrangement should be come to for ensuring a systematic direction of the inquiry, and for reporting the results, would suggest that there should be some officer or committee appointed to select localities at which it would be advisable to place the trained observers, and to make the necessary arrangements for conducting observations under the instructions.

It is a matter of obvious necessity that, as a rule, the observers should not be taken away from any locality at which they may have been placed, or from any inquiry they may have entered on, until they have completed their work there.

The Commission would suggest that the ordinary every-day work of the scientific observers should be directed towards obtaining normal constants of healthy localities. It is quite as important to obtain a true picture of the natural condition of healthy air, soils, waters, articles of food, organised structures, post-mortem appearances, &c., when there is no cholera, as it is to obtain a picture of the same objects during a cholera epidemic.

QUESTIONS. REPLIES.

A similar remark applies with equal force to inquiries into the same class of facts in localities where cholera is always absent, and in localities where it is always endemic.

One advantage of this procedure would be that when cholera was about to invade any locality in which the observer happened to be at work at the time, he might have the opportunity of watching any changes in the objects under daily observation.

The observers could always be transferred to localities where cholera had broken out, there to conduct special observations called for by the appearance of the disease. But in all changes of the field or of the subjects of observation, the observers themselves should be consulted.

Reports might be called for on any part of the instructions at stated times; or special inquiries and reports on any section or portion of a section of the instructions, or specific replies to specific questions contained in the instructions, might be called for.

For example, reports with drawings might be furnished by the two scientific observers on each division of their section in localities where cholera is absent, and again where it is present.

It is most important also that reports and illustrative drawings should be printed as soon as possible after being laid before the Government of India.

No attempt should be made to report on the results of the inquiry until a sufficient number of facts and a sufficiency of experience has been accumulated and printed to enable all persons interested in the subject to form their own opinions.

Copies of these printed reports should be sent to the India Office at home as soon as practicable.

If deemed to be desirable by the authorities in India, the Army Sanitary Commission would willingly place itself in direct communication with any officer or committee appointed to direct the inquiries in India, or with the observers themselves, so that any difficulties met with by the observers, and any points or questions regarding improved methods of inquiry or as to the precise nature of objects discovered under the microscope, might be promptly dealt with.

J. HOPE GRANT, Q.M.G., and President
DOUGLAS GALTON.
JOHN SUTHERLAND.
H. H. MASSY.
T. A. L. MURRAY.
W. E. BAKER.
J. R. MARTIN.
ROBERT RAWLINSON.

J. J. FREDERICK, Secretary,
Army Sanitary Commission, War Office,
July 8th, 1870.

APPENDIX.*

REPLIES TO QUERIES FROM THE ARMY SANITARY COMMISSION REGARDING REGIMENTAL ARRANGEMENTS IN INDIA, BY THE DIRECTOR GENERAL OF THE ARMY MEDICAL DEPARTMENT.

I cannot, I think, better reply to the queries put to me by the Army Sanitary Commission than by forwarding a letter from Inspector-General Dr. Muir, at present Principal Medical Officer of H.M. British troops in India, and extracts from a letter forwarded to me by Inspector-General Dr. Beatson, *late* Principal Medical Officer, British Troops in India. I may say I quite concur with both these officers generally in their views, both on account of the soundness of the principles they inculcate, and from the fact that the position that one of them now fills, and the other did lately fill, gives them an unparalleled practical experience which is enhanced by the well-known clear judgment of both of them. Without entering into the queries in detail, I will only offer a few general remarks, as I think Dr. Beatson's and Dr. Muir's communications include nearly everything needed.

Composition of regiments for India.

1. I beg to attach a statistical table showing the mortality of European soldiers at different ages in India; but, as Dr. Beatson remarks, it indicates the effects of climate from length of service in India, not really by age. I may add that I have received lately from numerous medical officers in India, reports deprecating the sending out to India young and delicate soldiers. The 92nd Highlanders suffered from typhoid fever soon after reaching India, and Deputy Inspector-General Munro largely attributes it to the immature age of the large proportion of the men amongst whom it chiefly prevailed. A similar complaint is made regarding the 21st Fusiliers, by a board which reported upon the great prevalence of malarious fever in the regiment while at Kurrachee; and Deputy Inspector-General Menzies makes a very decided statement to this effect as regards the 62nd regiment stationed at Lucknow, which suffered much from sickness, including cholera. These are only a few instances amongst many. I am fully of opinion soldiers should not embark for service in India under 20 years of age, and that even immature men of 20 should be held over for still longer.

Arrangements for arrival in India at proper season.

2. This has been very pertinently replied to by Dr. Beatson, and from November to January is no doubt the best season for troops to reach India. If, however, a certain force is to be moved in a limited time by a limited number of transports, there seems very little scope for arrangement. The general principle would be to send out the troops for the most distant and least accessible stations first, and to locate those arriving latest in healthy stations close and accessible to the port of disembarkation. Were Dr. Muir and Dr. Beatson's propositions, to send all regiments on first arrival in India to the hills, carried out, there would be no difficulty in the matter; but, until the provision of these stations is made somewhat as Dr. Beatson proposes, the arrangement cannot be carried out in its entirety, but so far as it can, in the meantime, it would be all important to introduce the principle, and locate as many of the European troops as possible in the mountain ranges; and the proposal that all regiments should spend their first two years of Indian service in the hills, and the subsequent rotation of plain and hill service, is calculated to be of the very highest value in its health aspect to the European soldier. It is fairly deducible that, if the European soldier is placed in the hills where heat is not felt, and malaria reduced to a minimum, a considerable step towards assimilating his position to that to which he has been accustomed in his own country will be obtained. The great experience that a long series of years has afforded of the healthiness of the hill stations in the Bengal Presidency, from the residence there of civil and military servants of the State, shows that these localities would be very influential in preserving the health of Europeans reaching them in health. Though not the European's climate, they approach it, and, probably, in no indication is this more clearly evidenced than in the effects upon European children, who thrive wonderfully in some of the hills, presenting the ruddy healthy look of the most favoured regions of Europe. If the principle of sending regiments to hill stations on their first arrival in India were adopted, it is probable that, up to a late period, they might be conveyed by rail to within an easy distance of the Bengal hill stations. And arrangements might be made for the latest arrivals each season to reach Jakatala or Bangalore in the Madras Presidency from Bombay, viâ Beypoor, by water, and from thence by rail. I do not quite concur with Dr. Muir as to the plan he recommends of confining regiments to provinces or districts, as by such arrangement some regiments might be doomed to spend the time they occupy stations in the plains in exceptionally unhealthy climates. Thus, regiments in Lower Bengal, or portions of Central India, would be very badly placed in comparison with regiments serving in less malarious places.

It would seem more judicious to move them about, all taking their turn of the less healthy stations, but not proceeding from one to another unhealthy station. I am not in accord with Dr. Muir in his disapproval of marching troops in the cold season. It is no doubt attended with expense, but the experience derived from campaigning in India clearly points to great advantage to the health of the men from the exercise, and change of scene and air, and of mode of life, which are associated with marching in the cold weather.

Period for selection of invalids in India, and proper season of arrival in England.

3. The proposal of Dr. Beatson on this head is deserving of careful consideration. Some time ago I brought the matter to the notice of the Principal Medical Officer in India. The "Crocodile" arrived on 12th January last, and the great mortality amongst sickly men from India on her passage home, and after the men reached this country, very forcibly impressed this subject upon

* The Director General's replies on points contained in Dr. Cuningham's questions to the Army Sanitary Commission were inadvertently omitted in sending the Appendix to press.

me. There is no doubt that men who are in debilitated health, or the subjects of many forms of organic disease, the result of service in India are very liable to have their condition greatly aggravated by arriving in this country in the winter.

It might be possible to arrange one other passage homewards annually by the overland troop ships for invalids.

When invalids are sent home in the winter by overland route, the hospital at Suez should be used to the extent of its accommodation for such cases as would be likely to suffer by reaching England during the winter.

4. My remarks upon this query are included under No. 2.

Hill stations. 5. I have nothing to add to the observations of Dr. Beatson on this question.

T. G. Logan,
Director General,
Army Medical Department.

6th May 1870.

Abstract showing the Ages of the Troops serving in Bengal, Madras, and Bombay, and the Deaths at each Age, during the Year 1868, &c.

Station.	Under 20.		20 and under 25.		25 and under 30.		30 and under 35.		35 and under 40.		40 and upwards.	
	Strength on 1st Jan.	Died.	Strength on 1st Jan.	Died.	Strength on 1st Jan.	Died.	Strength on 1st Jan.	Died.	Strength on 1st Jan.	Died.	Strength on 1st Jan.	Died.
Bengal - -	1,493	22	8,123	132	12,019	200	6,267	181	2,011	82	362	19
Madras - -	317	4	2,253	18	3,896	92	1,881	74	595	24	113	8
Bombay - -	448	3	1,988	30	2,775	27	2,030	47	671	20	90	5
Total -	2,258	29	12,364	180	18,690	319	10,178	302	3,277	126	565	32
Ratio of deaths per 1,000 of strength	12·84		14·56		17·07		29·67		38·45		56·64	
Ratio of deaths per 1,000 of strength in Bengal, 1862–66, Madras and Bombay, 1861–66	7·68		16·11		24·64		32·18		41·94		56·01	

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APPENDIX.

Medical Department, British Troops, Inspector General's Office,
Calcutta, 31st December 1869.

Sir,

In continuation of previous correspondence, I have the honour to offer the following observations for the consideration of His Excellency the Governor-General in Council.

In these days of retrenchment it will, I think, be readily conceded that no economy is more real and vital than that which reduces the sick rate of the British force serving in this country.

A sick soldier is an expensive article. He requires medicines and medical comforts to be provided for him; doctors and medical establishments to be kept up for him; hill sanitaria to be maintained for his convalescence, and costly transports for his removal to England when such becomes necessary.

The following suggestions are submitted in the belief that, if acted upon, economy in the saving of life and health (to take no higher view) will result.

Young soldiers. I. One pregnant cause of the high ratio of sickness and mortality among the European troops in this country is the large number boys or growing lads who are sent out to fill its ranks.

To take, in illustration of this statement, four regiments out of those which arrived last year, the following table will show that nearly one-fourth of the aggregate numbers consisted of lads under 20 years of age:—

Regiments.	No. under 20 years of Age.	No. of Recruits not yet discharged Drill.
92nd	239	116
1/6th	165	13
85th	155	96
2/60th	163	9

Now, it is a fact, substantiated by all experience, military and medical, that soldiers of immature age and development do not thrive when transplanted to the plains of India. Of what avail are our expensive new barracks, our advanced sanitation, and all the means and appliances so liberally provided by Government for the preservation of the health of the European soldier, if so large a proportion consists of such delicate material. If, as I understand, the Government of India is charged with the maintenance of the Indian depôts in England, surely it has a right to demand that no soldier be embarked for service in India who has not completed 20 years of age.

There is another point connected with this head also worthy of attention; viz., the return of invalided soldiers to India before they have had time completely to recover their health by the change to England. Of this we have very recently had an instance in the case of several men of the 26th Regiment who were sent home a year ago, returned to India in October last, and are about to go back again to England during the present or next month as invalids. Although this point has been taken up and pressed by the Medical Department, it would seem that the authoritative interposition of the Government of India is still wanted to ensure a stop being put to a practice so short-sighted and wasteful of public money.

Mode of relief. II. Is the mode in which European regiments are brought into this country, and afterwards moved from station to station in the course of reliefs, that most consistent with considerations of health and economy?

Putting aside for the present the military and political aspects of the question, let us see what is the ordinary routine in these movements.

A regiment arrives at Calcutta from England, and is sent up to some station in the North-west, or Punjaub, as Agra, Meerut, or Lucknow, and thence works its way up to Peshawur, whence it is moved to Central India or Bengal; or it arrives at Bombay, is despatched to the Punjaub, moves eventually to Peshawur, thence down to the North-west or Oudh, or perhaps to a hill station, and thence to Central India.

To give examples:—

90th Light Infantry.
7th Fusiliers.
93rd Highlanders.

1. The regiments named in the margin moved from Calcutta to a station in Oudh, thence to Allahabad, Agra, Meean Meer, and Peshawur, from Peshawur to the hills, and thence to Central India.

52nd Regiment.
72nd Regiment.
Rifle Brigade.

2. Again, others from Peshawur have moved to an intermediate station in the Punjaub and then to Central India; others from Central India to hill stations, then to Peshawur, and thence back again to Central India or Bengal.

Now it does not fall within my province to discuss the mooted point as to whether periodical displays of our strength are necessary to the conservation of our prestige in the native mind, nor to do more than point out, *en passant*, the enormous expense which must be caused by thus moving regiments from Dan to Beersheba.

I confine myself to the medical phase of the question, and proceed to enquire if there is any risk to health involved in the system of rotation sketched above?

I think most medical officers, if canvassed, would reply that these moves, involving often abrupt changes of climate, were trying and not unfrequently injurious to the health of the regiments. But there is one point on which no doubt whatever exists. It is the fatal effects sure to follow from moving a corps from one malarious district to another. Regiments that have served in stations in Bengal, or in Allahabad, Agra, and Meean Meer, are unfit for service in the Peshawur valley, and are

invariably prostrated by malarial influences there, from which I believe none ever recover during the remainder of their service in India, even after a residence of 12 or 18 months at a hill station, and never, certainly, if sent to a station in the plains, where malarial influences are more marked than in others.

To send regiments tainted with and not perfectly recovered from malarial influences to another malarious district is, I repeat, a mistake, so far as the regiments are concerned, and sure to prove an expensive mistake to the State. It requires years to get rid of malarial taint; and even when the constitution appears to have recovered, the least re-exposure to malarious influence will again produce disease. No man who has once suffered from ague in India ever *completely* shakes it off, until he quits India for a time.

Again, I consider it a mistake to send regiments that have served six or seven years in the plains direct to Peshawur, because the constitutions of the men, more or less exhausted, are unable to withstand the pernicious climate of the valley. Before proceeding to Peshawur, such regiments should, in my opinion pass two years in the hills, and after having completed their period of service in Peshawur should again be sent to the hills.

The 93rd was sent to Peshawur after six years' service in the plains, was there prostrated by epidemic cholera and ague, from which latter it did not recover for two years. In the beginning of 1867 it was sent to Jhansee and Sepree, and during last year ague again appeared in nearly all the men who had suffered from it in Peshawur and Sealkote.

Again, the 104th regiment suffered much in 1865–6 from ague in the same stations. It proceeded to Dugshai in 1867, where cases of ague were frequent, and last cool season to Peshawur, where in the autumn it was struck by epidemic cholera, and suffered severely.

Bengal Proper, Jubbulpore, Jhansi, Seepree, Morar, Benares, Allahabad, Cawnpore, Agra, Meean Meer, Peshawur.

The whole plain of India is more or less malarial, but the stations marginally noted are decidedly the most unhealthy, as shown by the frequent, nay constant prevalence of cholera, remittent and intermittent fevers.

It may be laid down as an axiom, therefore, that no regiment should be sent from one malarial district *immediately* to another; *a fortiori*, that no regiment which has suffered much in a malarious district be sent to another malarial district, even should it have been at an intermediate healthy station for one year or even eighteen months.

Without presuming to examine too critically the system of relief as it has obtained of late years, enough, it is believed, has been adduced to show that, so far as medical reasons go, it has not always been carried out in accordance with their dictates, as evolved by experience.

Whether in the rotation of stations any fixed plan has been, as a rule, pursued, or all has been haphazard, favour or caprice, I shall not undertake to say. Of late years I can aver that the sickly state of a regiment has been its surest passport to a healthy or a hill station, or a working party in the hills, but it does not appear that this principle has been always acted upon in the selection of corps for these envied locations.

In a word, the system, if system it can be called, does not seem, whatever military merits it may have had to recommend it, to have been that most consonant with sanitary considerations. Can a better be substituted?

NOTE.—Within the last 11 years, regiments are known to have been *twice* sent to hill stations. Others have never been in a hill station at all.

The 101st has three times had the benefit of a hill station in 12 years.

The 104th twice in the same period.

Other regiments (7th, for example) have always been in so-called unhealthy stations.

With a view to solve this question, I had the statistics of sundry British regiments examined, their medical history carefully traced in connection with the several stations to which they successively passed, and had hoped to have evolved some data on which to base a sound system of relief or rotation; but the evidence, when collected and compared, proved so conflicting, on account of the very different conditions under which the regiments in question came to be reviewed *aupres* previous and present state of health, length of service in India, &c., that the attempt was abandoned as impracticable.

The following, however, is a proposal which will obviate many of the difficulties connected with this subject, and, if carried out, will, I am sanguine enough to believe, be attended with great saving of life and money.

1. I propose that all regiments coming to India should be sent to serve in particular provinces, the Punjab, N.W., Central India, Bengal; and that they should not leave these provinces under ordinary circumstances during their stay in India.

2. That each regiment should have a hill station in connection with the one in the plains, for which the Himalaya and Rajmahal range offer every facility in Bengal, while the Neilgherries, Mahabeleswar, and other hill sites are equally available for the requirements of Madras and Bombay respectively.

3. That, so far as practicable, a regiment on arrival in India should be sent to a hill station at a high altitude for two years, where it should hut itself, have no regimental establishment allowed except sweepers, and should do everything for itself as in England.

After two years' service in the hills, the regiment should be brought down to the plains, remain two years at the station of its appointed district, during which time the regular establishment of servants should be supplied to it. The next two years again should be passed in the hills, but at a lower altitude, and all servants, except sweepers, again withdrawn. The fourth period of two years should be spent on the plains; and the fifth period of two years (which should be the last in India) should be on the hills, but at a lower altitude; and from thence it might go direct to England at any season of the year.

In this way regiments would serve ten years in India; six of which would be in the hills, and four on the plains.

I am quite aware that this plan pre-supposes a redistribution of the army, and an allotment to hill stations of a much larger proportion of the European force than obtains at present.

This is so vital a question as affecting the health of the army in India generally, and involves so directly the feasibility of the scheme which I have proposed, that it seems desirable to consider it a little more in detail.

Supposing then that the troops were permitted to hut themselves in suitable localities in the hills, as suggested, the question comes up, could any and what numbers now in garrison in the plains be withdrawn therefrom without jeopardizing our hold on the country?

On this head, I am aware statesmen and commanders of great Indian eminence differ; some maintaining that one half of our force might safely be located in the hills, while others hold that any reduction of the present numbers in garrison in the plains would be the signal for *emeutes* among the more turbulent population of India, to suppress which our troops would be constantly descending from the hills.

I am not aware to which side of this question the present Government inclines, but the fearful ravages of cholera during the past year embolden me to bring this subject under the consideration of Government as one, if not the most serious that can engage its attention. If the extension of railways to the foot of the hills, the formation of entrenched camps or forts at the larger stations in the plains, or other means and improvements which military men are only competent to deal with and devise, could accomplish the consummation desired, no time, I respectfully submit, should be lost in carrying these works into execution. All our efforts to stay the ravages of cholera have hitherto been fruitless. These ravages appear on each successive outbreak to be on the increase, both as to frequency and virulence; and, in the present state of our knowledge, our only safety consists in the withdrawal of as many of our troops as possible to hill stations. Here, although cholera is not unknown, it is an acknowledged fact that its visitations are comparatively unfrequent, and its force shorn of much of its virulence. The present lamentable state of the 58th regiment and the recent fearful tragedy at Peshawur call aloud, I respectfully submit, for inquiry into a policy which condemns so many victims to a premature death, with a view to the possibility of its modification or reversal. Public opinion, and the difficulty of keeping up a supply of recruits, will, if I mistake not, sooner or later, force this whole subject on the attention of Parliament.

One further remark I would venture under the present head:

It is during the first and second years of service in the plains of India that regiments are most sickly, and the mortality during these years is often greater than that during the whole of their remaining service in India, epidemic disease excepted. This is a very significant fact, and one which does not seem to have received that recognition which its importance demands. It points to the expediency of all newly arrived regiments and drafts passing their two first years of service in the hills so far as is practicable, whatever be the system adopted with regard to their after movements.

Another point is deserving of a passing remark. Why should regiments sent to the hills not hut themselves instead of being accommodated in expensive permanent barracks, which are there quite out of place? I have reason to know that under proper engineer supervision they could perfectly well do so, and they should have nothing but *tentes d'abri* allowed them until they do so.

Apart from the saving to Government by utilizing soldier labour (the value of which is only now beginning to be recognized) the practice as a training for active service and as a source of recreation cannot be over-rated. The employment of soldier labour, so conspicuously successful in road-making in the hills, falls yet far short of the point to which it should be carried.

Vide Horse Guards' recent Order.

To sum up. The following benefits appear derivable from the above proposals:

Regiments would pass half their period of service in a comparatively good climate. Invaliding would be reduced; mortality diminished. Regiments would be kept in a more efficient condition, and the State saved enormous expense.

To march regiments from Peshawur to Sangor, from Sealkote to Jhansie, from Jhansie to Dugshai, and from Subathoo to Kamptee, must cost lacs of rupees.

Allotting regiments to provinces, and moving them only within this Province, from hills to plains, and *vice versâ*, would save health, wealth, and life.

These remarks, it is hardly necessary to add, refer only to times of peace. Military must always over-ride all sanitary considerations.

Convalescent Depôts.

III. Do Convalescent Depôts pay? or, in other words, does the Government receive an equivalent for the expense of their maintenance?

It is the opinion of some of the most experienced executive and administrative medical officers who have given attention to the subject, that the benefits accruing from these establishments are not equal to their expense.

With this verdict I am very much disposed to concur. Soldiers who once go to a hill depôt frequently either have to be invalided from the depôt, or return the following year to the hills, or are invalided from their regiments. I have known men to be sent three years in succession to hill depôts (a practice which I have latterly taken steps to abate), and at last invalided to England. In truth, once a man goes as an invalid to a sanatorium, he is too apt to consider himself, and to be regarded by his comrades, as a confirmed valetudinarian, from whom "a good day's work for a good day's pay" is not henceforward to be expected; and so he eventually drifts to Netley. With the view of ascertaining what proportion of men who have passed a season at a hill depôt eventually become fit for duty in the plains, and remain so, I have lately circulated among medical officers a series of queries, but the replies which these have elicited are not so positive and comprehensive as to warrant reliable deductions being drawn from them. In fact, the statistics of hill depôts seem to have been kept up in a very loose and perfunctory manner; a practice which will not be so henceforward. These inquiries will be further prosecuted; and, if I find grounds sufficient to justify the steps, I will take the liberty of submitting to Government the expediency of doing away with these depôts, and appropriating the existing buildings to regiments or wings of regiments.

If my suggestion of sending regiments to hill stations every alternate two years were adopted, convalescent depôts would no longer be required, and thus, besides the saving in money and life by the rotation system of hill service, and restriction of regiments to provinces, there would be a further large saving effected, by sending invalids at once to England, instead of in the first instance to hill depôts, to which a commandant, station staff officer, sergeant majors, quartermaster sergeants, &c. &c., are appointed and paid extra, to say nothing of the medical officers and native hospital establishments, all of which might then be dispensed with. If a soldier required a change to the hills he could have a furlough, or be attached for a time to a regiment serving there.

These hints are thrown out in the hope that the subject may attract the notice of Government, and perhaps call forth some decided action in order to determine the usefulness of these establishments or otherwise. In weighing the advantages to be anticipated from a residence in the hills, it should never be forgotten that the balance of medical opinion is *against* the hills as *curative* means or agencies. Their real value consists in *keeping men well* whose constitutions are yet unbroken.

The New Standard Barracks.

IV. A reaction, arising out of what it is the fashion to call the "financial crisis," has lately arisen against these permanent barracks, chiefly owing to their costly character, and their not having fulfilled all the expectations that were formed of them, which there is some risk of being carried beyond due limits, with the effect of undervaluing structures that are far superior to anything of the kind that has gone before them, and which must be regarded as an inestimable boon conferred on the British soldier doomed to service in the plains of India. That they are not perfect, that they are hot and in some respects uncomfortable, that less expensive structures would equally well have fulfilled the required conditions of a healthy barrack, are truths that cannot be gainsaid; but to aver, from what took place at Allahabad and Peshawur during the recent cholera epidemic, that they are no better, but worse, than the old fashioned structures which they superseded, in regard to warding off the inroads of cholera, is not a fair statement, but a perversion of the facts; for, as regards Allahabad, it is well known that the men of the 58th Regiment were cholera-tainted before they entered them, and that the surroundings of the buildings, when taken into occupancy, were in anything but a satisfactory sanitary condition. The same exculpatory plea might easily be set up in regard to those at Peshawur, if necessary. In fact, none of these barracks have yet been occupied sufficiently long to warrant a fair judgment being formed of them.

That the men should prefer the upper story, where they can lounge on their beds and smoke their pipes, to the recreation room, where they are confined to a narrow form as a seat, is intelligible enough to all who know the habits of soldiers in India. It was, however, undoubtedly a great mistake to adopt one uniform standard for conditions of locality and climate so varied and opposite as the cantonments in the plains and hills of India exhibit.

In the swampy malarial cantonments of Bengal Proper, two-storied buildings were indispensable; but in the drier climate and soil of the Punjab and upper provinces, the same amount of raising the occupants from the ground was not necessary, and a one storied edifice elevated on a plinth four or five feet high, would have answered every purpose and saved a large part of the total outlay.

That these two storied barracks have been found unexpectedly hot might have been almost predicted from their extensive wall surface, height, nature of roof, and in some cases their position; but happily some of these defects are remediable. The double or Jubbulpore roof must be supplied where wanted, and can be so, I understand, at small expense. The open verandahs, against which the sun beats, must be protected by large sunshades or jalousies; and in the Punjab and all dry up-country stations, the lower story can be safely used as dormitories (the men dining in the verandahs), and thus much of the odium attaching to these structures will be done away with.

As to their erection, *pur et simple* at hill stations, nothing can justify so wasteful an expenditure of public money; such extravagance is simply sinful.

The decision which the Government will come to on a review of the whole subject will be, I trust, that no more of these expensive structures shall be built.

The kind of barrack that is wanted for the greater part of the plains, save Lower Bengal, is an inexpensive building of sun-dried bricks, with a sunproof roof, and provided with the other necessary conditions of space, reasonable segregation, and efficient drainage. Such structures, in the event of any locality becoming frequently unhealthy, could be thrown down and erected elsewhere, the materials being used a second time.

One drawback to these standard barracks is that they tie us down to a locality which it may be found desirable on grounds of health to abandon.

On the whole, then, let us be thankful for these so-called "palatial residences." They will be a standing monument of the benevolence of the Government which called them into existence, and before many years will amply repay, in the improved health of the British soldiery, the sums that have been expended upon them, even should these have been larger than what was absolutely required.

I have, &c.
(Signed) W. M. MUIR,
Inspector General of Hospitals,
and P.M.O. British Troops.

The Secretary to the Government of India,
Military Department, Calcutta.

REMARKS BY INSPECTOR-GENERAL DR. BEATSON, ON REGIMENTAL ARRANGEMENTS IN INDIA.

QUERY.

1. What should be the composition of regiments sent to India, to avoid the losses consequent on allowing unsuitable men to go there?

1. I believe that one cause (and not an inconsiderable one) of the mortality in regiments in India, particularly in regiments newly arrived in the country, has its origin in the immature age at which many of the men are sent out to India.

2. It is true that, at first sight, statistics do not appear to bear out the idea that the death rate is greater among this class than among those more advanced; in fact mere figures seem to prove quite the contrary, that is, the per-centage of deaths will at any time appear to be considerably increased during each quinquennial period of life.

3. If figures go to show this result, how can it be established that the mortality is really greater, although apparently less, among those who go to India as boys than it is among those who arrive in the country at a more mature age? I think the fact which is generally believed and accepted might probably be proved by figures in this way, viz., by carefully comparing the statistics according to age among men (up to 35) who have been the *same length of time in India*, for it is this latter element that, in my opinion, goes considerably to swell the mortality with each advancing period in life.

4. Then, again, the larger proportion of lads under 20 may not have arrived in India till they were 19, and thus, although their health may suffer, they may not actually succumb during their first year of service, but during a subsequent one, and so increase the death rate from 20 to 25.

5. Of course I am quite well aware that in times gone by many (I do not think there are many now) entertained the idea that men become inured to the climate of India, and that the more complete the process of so-called acclimatization, the more safe the life of the individual, and the more safely could such an individual undergo exposure and hard work in an Indian climate. All statistics, however, (analyse them as we will) prove this to be a mistake, and clearly show that with advancing age, and it may be presumed, as a rule, with proportionally longer Indian service, the mortality among men, say from 30 to 40, is twice as great as it is among men from 20 to 25.

6. Residence in the plains of India involves, and, in nine cases out of ten, is inseparable from, deterioration from the standard of health in the European constitution; and when I have heard, in disproof of this opinion, an allusion to the hale old European pensioners formerly located at different circles in the plains of India, I could not help asking myself the question, "How many dead men do each of these living ones represent?"

7. The above consideration is to my mind a complete answer to those who would urge the expediency of again reverting to a local European force for India; such a change would be a retrogression; in fact, an impracticable one, inasmuch as the circumstances of military service have of late years greatly changed, and are still changing, under the improved and improving conditions of enlistment, all which improved conditions must be equally applied to every soldier of Her Majesty, whether he elects to serve Her Majesty in Her Indian possessions or elsewhere.

8. The first element of localization was the acceptance, on the part of the recruit, of the condition of *long* and *continuous* service in India; this element, however, is at once disturbed by the limitation of every man's period of enlistment (for the infantry) to ten years, to be, I doubt not, yet further considerably reduced, at all events as regards foreign service.

9. It is, therefore, useless to consider whether or not continued residence in India secures immunity from disease; but altogether apart from the theory of acclimatization, every one of Indian, or in fact of any tropical experience will, I think, allow that for the first year or two of service in the tropics every man requires to be more careful of his mode of life, inasmuch as he is undoubtedly more susceptible during the above period to attacks of acute disease; on which account it is highly desirable that his constitution should be *fined* down from the robust plethora of English health in a climate which would produce this change, without at the same time causing deterioration of constitution.

10. This object could, I conceive, be easily attained if it were understood that in all ordinary circumstances, that is in all quiet times, every

newly-arrived regiment should occupy for the first two years of its Indian service a hill station.

11. If this can be accomplished, and a rule enforced that no lads should leave England for India until they have completed at least their 20th year, I would feel hopeful that the mortality in newly-arrived regiments would be greatly diminished.

QUERY.

2. What arrangements could be made to ensure the arrival of troops in India at the proper season?

1. This second question is not very easily answered. If the question simply were, what is the proper season for troops, fresh from England, to arrive in India, an answer could easily enough be given; but to say *what arrangements can be made* to ensure the arrival of troops at proper seasons is a much longer question; in fact, all that can be said is, that it is entirely a question of the number of regiments and of details which have in any year to be sent to India, and the amount of the means of transport at command.

It may be safely said that it is most desirable on sanitary grounds that all the arrivals should take place before the 1st of January in each year; and to this it may unhesitatingly be replied, that with existing means of transport, and with the present number of men to be sent out annually, their being all in India before 1st January is simply an impossibility; for while it is desirable that all should arrive before the beginning of the year, it is equally desirable that none should go down the Red Sea before the middle of October.

2. Those conditions could of course be met by sending one half of the troops under order for India viâ the Cape, leaving England the beginning of September; but independent of other considerations, this would of necessity largely increase the expense of the relief.

QUERY.

3. Also the departure of invalids from India, so as to ensure their arrival at the proper season in England? and their selection in the most favourable time in India? The present system is faulty on both heads.

1. My opinion is, that men who are to come home viâ Egypt should not as a rule arrive in England before April; in other words, should not leave India before the middle of March, or anyhow not before the beginning of that month; and further, that the Invaliding Committees in India should not sit before the end of December or early in January. It is an extremely difficult matter to get old-established rules and routine altered in India. These Invaliding Committees have sat for, I dare say, nearly half a century in October, and their assembling at that time is looked upon as one of the institutions of the country; but the India of the present day is not the India of fifty years ago, in fact is not the India of ten years ago, a fact which willingly or unwillingly must be accepted, and must always be kept in mind.

2. When October was the month fixed upon for the assembling of the Committees to examine and report on men brought forward for change of climate, the reasons for fixing on that month were good and valid ones. In the first place, after the men had been passed, all their papers, military or medical, had to be prepared or completed (this of course has to be done still), and it might fairly be presumed that the preparation of these documents would occupy at least three, or perhaps four weeks. After the completion of their papers, the men had to be despatched by ordinary route marches, or by boats to the Presidency, where it was desirable to have them available for embarkation in all January, so that they might arrive in England about the end of April or the beginning of May.

3. How changed is all this now? And how much greater will the change be when the Grand Trunk Railway system, now rapidly advancing towards completion, is finished? No man will then be many days distant from port of embarkation, and the time which it will take to get him there can be calculated exactly. There can therefore be no objection if the invalid and weakly men are not, as a rule, to be embarked till the beginning of March to not bringing them before Invaliding Committees till January. One thing is quite certain, and of this I am every day more convinced by my experience in invaliding men at Netley, that many men are sent home needlessly from India; not from any carelessness or neglect on the part of the Invaliding Committees, but simply from the fact that many men, worn down by the heat during the summer months, look so ill at the end of the hot season as to justify the belief that they really require a change. After three months of the cold season in the Punjab or N.W. Provinces, the same men would scarcely be recognised as the same individuals, but they *have been passed*, and *therefore* must go home.

4. The advisability of deferring the assembling of Invalid Committees till January was brought forward by Surgeon Furlong, 6th Dragoon Guards, through His Excellency Sir Robert Napier (now Lord Napier of Magdala), then Commanding-in-Chief at Bombay, in the summer of 1867, and when referred to me, I recommended the suggestion of Surgeon

Furlong as well worthy of attention. I left India soon after, so I am not aware if any further consideration has been given to the subject.

5. Another painful fact has (during the past spring especially) been made evident at Netley, and that is, that many of the men invalided on account of tropical disease, especially dysentery, have had their symptons greatly aggravated by the sudden change of temperature on this side of Egypt, and have suffered all the more on account of an insufficiency of warm, especially under-flannel, clothing, which all men who are at all weakly, in fact all invalids, should have issued out to them on embarking at Alexandria; this flannel under-clothing should invariably include drawers as well as a flannel Banian with sleeves.

5. It is almost needless to say that patients labouring under consumptive disease, or tendency thereto, have also suffered severely from the sudden changes of temperature; indeed the results were so serious among the invalids by a late ship (the "Crocodile"), and the deaths from pneumonia on board ship, at Netley, and in hospital at Portsmouth were so numerous, that the subject was brought to the notice of the Director-General, Army Medical Department.

6. A man must be strong and sound to bear such sudden change and diminution of temperature as he must be subjected to, in leaving the mild weather of a tropical winter at Bombay, to be in little less than a fortnight in the cold winter of more northern latitudes; indeed, considering that there is now a hospital establishment at Suez, my opinion is that the Invaliding Committees should distinctly report whether the invalid should proceed direct to England, or remain at Suez till the severe cold of spring is over.

7. It might be, however, advisable not to restrict the authorities in India from sending home early, by almost the first ships of the season, any men (especially if at a convenient distance from the port of embarkation) whom it might be considered would be likely to derive benefit from an early removal from India.

QUERY.

4. As no general plan at present exists for locating troops at suitable stations on their first arrival in India, and for a period of first two years of its service in the hills. To carry this out, however, several more hill stations would be required, over and above those which now exist or are in course of formation.

2. At present the hill stations, *not* including the small depôt station at Dhuramsalla (Bhagsoo), at which accommodation could be provided for entire regiments, are as follows:—

1. Darjeeling.
2. Nynee Tal.
3. Landour (to be vacated as soon as Chuckratu, near Pokri, is fit for occupation).
4. Kussowlie.
5. Dugshai.
6. Sabathoo.
7. Dalhousie (Baloon).
8. Murree.
9. Raneeket (not yet ready).

3. The latter is intended for a regiment, while at Chuckratu there will be accommodation for a regiment, and for a convalescent depôt. Dugshai and Sabathoo are also stations for regiments, and of late years there has been a wing of a regiment at Darjeeling; so that there will be four stations for regiments, and one, at which for some years past a wing has been accommodated. The remaining hill stations now in occupation, viz., Nynee Tal, Kussowlie, Landour, Dalhousie, Murree, and the small one at Bhagsoo, have been for many years occupied by details of convalescents; in other words, have been convalescent depôts, although they might, all except Bhagsoo, be made suitable for occupation by entire regiments

4. The question then arises, and may now be considered, in what way can hill stations be most *beneficially* utilized? a subject on which directly contrary opinions and views are entertained, as can easily be discovered by reference to the opinions officially expressed, and the recommendations founded on such opinions, which have been submitted to the authorities in India; my own opinion, and my recommendations while I was head of the Medical Department of H.M. British forces in India, being, I may at once say, diametrically the opposite of the views

entertained and of the recommendations submitted to Government of India by the late Sanitary Commission for Bengal.

5. My disagreement in the views of that Commission arose from no feeling of jealousy or of hostility, but solely from my belief that the views entertained by the President and by a majority (not by all) of the members were altogether wrong; and further that these views were not supported by facts, nor by the reasons assigned for having arrived at the conclusions which (in what was in some respects an able, or at all events a well-written, report) the Commission in the end of 1864 recommended the Government of India to accept as the basis for future arrangement in the matter of locating British soldiers in the hills.

6. A copy of that report is doubtless available to the War Office Sanitary Commission, the members of which can after perusal satisfy themselves whether or not I am in any way misrepresenting the opinions and recommendations of the Commission as embodied in their report. Of that report I have not myself a copy, so that I am speaking from my recollection of it, when (just five years ago) it was submitted to me for any remarks I had to make on the recommendations contained in it.

7. The report in question commenced with the enunciation of an opinion which is almost universally acknowledged to be a correct one; viz., that the hill climates of Northern India are more beneficial in the prevention than in the cure of tropical disease; and that an occasional sojourn in the hills is especially useful in warding off that general impairment of health almost invariably inseparable from lengthened residence in the plains of India. On this point the Commission and myself seemed to be quite agreed, while we differed altogether in the conclusions which we respectively deduced from the above acknowledged fact; my conclusion being, that if hill climates are chiefly beneficial (as they certainly are) in *preventing* disease, then men who are well, or at all events who are *not ill*, should be regularly sent to the mountains, to keep them up to the standard of health. The recommendation of the Commission, on the other hand, was to the effect that neither healthy men nor entire regiments should ever be sent to the hills, but that a sort of composite battalion of all the weakly and sickly men, excluding, of course, all cases of marked organic disease, should be formed for location in the hills; that is, that as long as a man is able to do his duty, although his health may be deteriorating all the time, *until, in fact, the one year more makes him too succumb*, he is to be kept grinding in the heat of the plains; while the weakly, the sickly and, let *me* add, the malingering and the lazy, are to have the enjoyment of a good climate and an easy life in the hills.

8. So far from my accepting the recommendation of the Sanitary Commission, that all the men sent to the hills should be selected cases of men whose health *was giving or had given way*, I would advocate quite a contrary arrangement, and would send periodically, and in their turn, entire regiments to hill stations, excluding merely the men who may be suffering from unmistakeable organic disease, all of whom had much better be at once invalided to England, as without such a change they are never likely to be really efficient soldiers in a tropical climate.

9. By thus giving men, *before they break down*, regular tours of the hills their health individually and as a regimental body may be, I conceive, greatly preserved, so as to enable them to get through their Indian tour of service with far less loss and inefficiency than at present take place.

10. What the tour of hill and plain service should be, as far as the *health* of regiments as a body is concerned, is a subject for mature consideration. My own opinion has always been that it should be *at least* two years in the hills for every four in the plains; this proportion of hill service I consider to be absolutely necessary, if it can be increased so much the better.

11. It is not for me to enter into the military or political aspect of the question of hill service for the British force in India, or to attempt to indicate what number of men can be so located with due regard to military and political contingencies, but one broad fact seems patent, that unless the present strength of British troops in India is to be viewed merely as a *peace* establishment, it must be allowed that we have a sufficient force to secure all the really important strategic positions, to hold military command of all the great centres of population, and at the same time to enable us to assume offensive military operations, if necessary, in the field. For this latter purpose one third, if not one half, of the British force would require to be available if need arose; and if it be so, why should not one third of the entire force in the country be, in peaceful times, available for location in the hills, at spots of sufficient elevation, but at the same time contiguous to the plains?

12. To carry out this system of relief, by which at least one third of the force could be accommodated in the hills, and by which each regiment would spend two years in the hills after every four in the plains, it would be necessary to have one hill station to every three regiments on the establishment. This would probably involve about three more stations than now exist or are being formed in Bengal, provided the invalid depôt system is abandoned and all the stations at which convalescent depôts now are be given over for regiments, and the accommodation at each completed up to the required extent.

13. At the several hill stations, if all are given over for regiments, there might be provided depôt accommodation for about 150 invalids at each, as from regiments in the plains there would probably be a limited number of men who would each year require temporary change to the hills. If, however, each regiment has its regular tour, *as a regiment*, of two years in the hills for every four in the plains, the number of men requiring change to the hills during their regimental tour of service in the plains should be much less than from regiments which often have, as at present, almost continuous service at hot and trying stations.

14. All the present convalescent depôt stations in the Punjab, except Bhagsoo, are quite well suited for the accommodation of entire regiments, provided the existing barrack accommodation were added to; although, as regards Kussowlie, and Dugshai also, the water supply, if not scanty, is very inconveniently situated, far down the hill. I have, however, always thought that a tank could be very easily formed, and a *large* body of water retained at the former station if the deep gorge (through which all the water drainage is effected) were dammed across by an artificial bund.

I have heard it said, that considerable difficulty in retaining water in the gorge, even if a dam were built, would arise from the porous nature of the soil, but if *puddled* with clay, that difficulty would be obviated to a considerable extent, and the water thus collected, although not fit for drinking and cooking purposes, would be quite suitable for those of bathing and ablution, purposes for which the greater portion of the water consumption is needed; a facility of supply for these purposes is therefore a matter of great moment.

15. The question is often put, would it not be desirable to have a certain number of stations which would possess what may be called an intermediate temperature, and with a more moderate rainfall than we have, at an elevation of 7,000 feet, on the front or southern ranges of the Himalayas? The answer to this is, Yes, it would be *very desirable* to have such stations, but where are we to find them in Northern India? I can only say that I have been a good deal over the front ranges of the Himalayas, and I have found no such localities, if we except Sabathoo, which is almost an exceptional feature in this part of the hills, forming as it were a flat tableland or hollow of limited extent, between the front or Kussowlie range and the second or Simla range of hills.

16. With regard to Sabathoo a good deal of difference of opinion exists; by many the locality is thought to have all the disadvantages of the plains with few of the advantages of the higher stations, especially as regards coolness. I do not agree in this opinion, for anyone who has come up direct from Umballa to Sabathoo must at once have felt the vast difference in temperature and in feelings experienced at the two places, the nights at Sabathoo being always comparatively cool, as may be expected at an elevation of 4,200 feet; indeed, if Sabathoo were less surrounded by hills and more of a plateau than a basin, its climate would be very enjoyable, and if more stations at the same elevation and with equally convenient access to the plains could be found, they would prove in many cases more beneficial to weakly regiments than localities 3,000 feet higher. Sabathoo itself has not hitherto (that is in years gone by) had fair play, for when I first knew Sabathoo, even as late as 1863, most of the barracks were exceedingly bad; new ones and good ones have since sprung up, and I doubt not the place will prove a healthy locality.

17. Of course it may be said that in the interior of the Himalayas, in the Chini district for instance, all the evils of heavy rainfall may be avoided, and a climate delightful, while the front ranges of the Himalayas are drenched in rain and enveloped in fogs, may be enjoyed; all this is quite true, but it is equally true that locating troops far in in the interior of the Himalayas is a simple impracticability; in fact, if suddenly wanted, it would be far easier to get a regiment from England than from Chini; practically therefore we must consider our hill locations for British soldiers as entirely confined to the first or second range of hills, that is, not further in than Simla; and my belief is that within that area there are ample sites to be found for any number of men that can be spared from the plains.

All access into the far interior, that is beyond the Simla range, may be said to be cut off, and all communication to be next to impracticable during the six winter months.

18. Again, apart from the mountain ranges, there are few healthy elevated plateaus in Bengal or in Northern India; nothing corresponding, for instance, to the Mysore plateau or tableland in Madras, on which, at an elevation of about 3,000 feet, we have one of the most delightful climates in all India; a truly intermediate climate, never too cold, and seldom uncomfortably hot. A glance at a map of India will, however, explain why this should be, and how very exceptional is the position of the Mysore district, situated on a comparatively narrow part of the peninsula of Hindostan, and within the influence of both monsoons, having always, in fact, the advantage of a sea breeze. The only other locality which I know, having some of the advantages, but only some, of Mysore, is the elevated tableland of Seonee in Central India, nearly midway between Nagpore and Jubbulpore.

19. It may no doubt be possible to find some few localities, such, for instance, as Looboghat, or Bukloh below Dalhousie, on the southern aspect of the Himalayas, fit for occupation by British troops, at an elevation considerably below 7,000 feet; but another glance at the map of India, on which are shown the elevations of the several mountain ranges, will indicate how abruptly, as a rule, the mountains in Northern India rise on their southern aspect from the plains, with little or no intermediate rising ground between.

20. Further, I may add, that where hills of lesser height intervene, as, for instance, the Sevalik range which encircles the southern side of the Deyhra Dhoon, such hills are not healthy, nor suited for occupation by British troops; indeed many of the lower spurs even on the northern side, below Mussouri and Landour, at elevations of from 4,000 to 5,000 feet are not considered to be beyond the influence of malaria rising from the plain of the Dhoon below.

21. We may therefore, in considering the question of having troops in the plains, or of locating them at higher elevations, practically confine ourselves to the consideration of hill stations properly so called; that is, localities at elevations of from 6,000 to 7,000 feet above the sea; an elevation at which, even if overhanging the plains, as may be said to be the case with Kussowlie, there is little risk of any injurious influence from malaria from the plains below, although not complete immunity from winds more or less hot.

22. Unless therefore we can ascend to this elevation, or find localities of similar topographical character with Sabathoo or Loohoghat, we had better look for healthy localities in the plains than risk the location of men at so-called intermediate stations; that is, at elevations intermediate between that of the plains and of 7,000 feet.

[On the question of barrack construction, to which several paragraphs are devoted, Dr. Beatson's views differ from those of other authorities, but as this point is not before the Commission, it is unnecessary to enter on it.]

42. Another important matter for the consideration of the War Office Commission, as closely connected with that of barrack accommodation, will be the recommendations they may see fit to make as to what should be the constitution of the force located on the hills. If the present system of invalid depôts, a system liable to great abuse, and of which we cannot say the results are or have been very satisfactory, be abolished, or at least greatly modified, a large amount of excellent barrack accommodation will at once be available in the hills, which, with moderate additions, would accommodate an entire regiment at each station now occupied by a depôt. The required addition to the accommodation at each station would be comparatively inexpensive, as it would consist merely of one or two barrack bungalows, there being already at most of the depôt stations ample hospital accommodation, sufficient married accommodation, and all the requirements of skittle alley, reading, recreation rooms, &c.

43. It would materially assist the drawing of satisfactory conclusions as to the real benefits that have been derived from the present system of hill depôts if the results of residence there on sickly and weakly men can be traced; and there should be no difficulty in doing this, nor, from the information thus obtained, of ascertaining how many men were permanently benefited by a residence at a hill depôt during one hot season, and further, how many men after one, two, or three seasons' residence in the hills, had after all to be sent to England. I myself believe that the information thus obtained would show that the present system has not been a success; at all events there is little doubt on one point, that no small proportion of the invalids who arrive at Netley come from a hill depôt.

44. I will now observe, before concluding these remarks, that when I have spoken of locating regiments in the hills of Northern India, I am not at all an advocate for keeping the men, who will thus be in a cool and healthy climate, in idleness; on the contrary, I believe that the very best results of a hill climate will be obtained by utilizing as has of late been done to a great and yearly increasing extent, the labour of the men in the making of roads, and in the building of their own barracks or huts; a consideration which at once raises the question, is it useful or expedient to tie men down to one particular spot by the erection of regular barrack buildings, or might it not be better to let them shift ground and rebuild fresh huts in the vicinity of any sphere of work which may be found for them? If this system were followed, regiments could return to the plains in the winter for military exercises.

45. Nothing can be more satisfactory or encouraging than the health statistics of the various working parties who have been employed in road making along the line of approach to new stations, as for instance, on the Abbotabad road near Murree, and on the new line of road which is now being made from Donaira to Dalhousie. In every way the men have benefited, and so has the State; the work has been well done, and at a saving of expense; the health and physique of the men have improved, while their conduct has been excellent. It is in fact most encouraging to study the health statistics of these parties; to witness in the returns an almost entire exemption from those diseases which in the plains cause such loss of health and life, and to see a recorded death rate of little more than at the rate of four per thousand per annum.

46. As to the men, by being so employed, suffering as soldiers, that is, as drilled machines, I think such a consideration is not worthy of a thought. A man, it is presumed, will be a drilled soldier before he is employed on road making or other military works; and as he will be so employed only during the summer months, there will be the winter ones to devote to more purely military duties; in fact we have a proof in the state of the Royal Engineers that a man may be an excellent workman, and be very constantly engaged at his trade, and be at the same time an intelligent, smart, and efficient soldier.

47. In the hot weather of 1863, the 101st regiment, which had suffered severely in health at Mooltan, was stationed at Rawul Pindee, with a large number of men at work on the new Abbotabad road near Murree, when suddenly, and from such excellent training, they were summoned for active service in the Umbeyla pass; there the men had to undergo great exposure, privation, and fatigue, but to all these they were fully equal, in fact the corps during this difficult and severe service not only sustained, but even added to the laurels of the justly renowned 1st Bengal Fusiliers.

V.—Hill Stations.
Should not arrangements be made for sending sickly men at once to the hills during the hot and rainy season?

This is the last query to be answered, and it is one which must be replied to with caution; indeed I greatly doubt the expediency or the propriety of attempting to lay down anything approaching to fixed rules on the subject. I would much rather leave the decision entirely to the authorities on the spot, for *extreme caution* must be exercised in the matter of moving sickly men even by railway in the hot weather in India; and when a man supposed to require change is at a station any way distant from the foot of the hills, such a move, if he did not die in transit, would probably remove all hope of his recovery.

From some other stations, Umballa, Roorkee, or Rawul Pindee for instance, or from the valley of Peshawur to Cherat, it might be possible, by a well-arranged system of transport, to give men even seriously ill the chance of benefiting by a move to the cooler climate of the hills; but in the wet weather, when, as a rule, men are suffering from acute disease of the liver or bowels, a sudden change to the cold and damp of a hill climate would be almost certain death. It is therefore out of the question for anyone not on the spot, and *weighing well* all the circumstances of each individual case, such as the state of the patient, the length of the journey, and consequent exposure involved in getting the sick men to the hills, to say whether or not removal in the hot weather would in any individual case be justifiable or not; as a *general practice* it would certainly neither be desirable nor safe.

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Royal Victoria Hospital, Netley,
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