Report of the commissioners appointed to inquire into the sanitary state of the army in India : with abstract of evidence, and of reports received from Indian military stations.

REPORT

OF

THE COMMISSIONERS

APPOINTED TO INQUIRE INTO THE

SANITARY STATE OF THE ARMY IN INDIA;

WITH

ABSTRACT OF EVIDENCE, AND OF REPORTS RECEIVED FROM INDIAN MILITARY STATIONS.

LONDON:
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PREFACE.

THIS Abstract of the more important documents, contained in the two folio volumes of the Report and Appendix of the Royal Commission on the Sanitary State of the Army in India, has been prepared with a view of affording information on the subject to Commanding, Engineering, and Medical Officers.

It is satisfactory to be able to state that, since the inquiry of the Royal Commission was begun, several of the evils described in the Report and evidence have been or are being removed by the zealous co-operation of the military and civil authorities in India.

The Sanitary Commissions for the Presidencies, as recommended by the Royal Commission, have been appointed, and put in communication with the Barrack and Hospital Improvement Commission at the War Office. Two members representing the India Government and one from the Local Government Act Office have been added to the War Office Commission. Suggestions for carrying out sanitary works in India, including water supply and drainage, &c., and improved plans for barracks and hospitals have been prepared by the joint Commission and sent to India.

Very important measures have been taken by the Commander-in-Chief in India for diminishing intemperance and affording means of occupation for the soldier.

The Abstract of Evidence and the Report, although still representing the condition of stations and towns, would require modification, as regards the soldier's habits, to represent his present state. The information, however, will be found useful, as showing what should be avoided, and the direction in which improvements have still to be carried out.

War Office, August, 1864.


MAP OF INDIA
Shewing the topographical position of the
Military Stations.
(Report of the Royal Commission on the Sanitary state of the Indian Army)
Longitude East from Greenwich
Months of the Indus
Months of the Ganges
Gulf of Cutch
Gulf of Cambay
Bombay
Madras
CEYLON
Cape Comorin
Gulf of Siam
MALAY

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ABSTRACT OF MINUTES OF EVIDENCE—*cont.* Page

(2.) INDEX TO SUBJECTS ARRANGED ALPHABETICALLY—*cont.*

ABSTRACT OF MINUTES OF EVIDENCE—*cont.*

(2.) INDEX TO SUBJECTS ARRANGED ALPHABETICALLY—*cont.*

ABSTRACT OF SANITARY DETAILS IN REPORTS FROM THE PRINCIPAL MILITARY STATIONS IN INDIA:

ADDENDA:

ADDENDA—*cont.*

REMARKS ON THE CLIMATE OF STATIONS—*cont.*

ADDENDA—*cont.*

REMARKS ON THE CLIMATE OF STATIONS—*cont.*

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ADDENDA—*cont.* Page

ADDENDA—*cont.* Page

COMMISSION.

VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith.

To Our right trusty and well-beloved Councillor, the Right Honourable Sidney Herbert, and to Our trusty and well-beloved Robert John Hussey Vivian, Knight Commander of the Most Honourable Order of the Bath, a Major-General in our Indian Forces, and a Member of the Council of India; Proby Thomas Cautley, Knight Commander of the Most Honourable Order of the Bath, a Colonel in our Indian Forces, and a Member of the Council of India; Thomas Alexander, Companion of the Most Honourable Order of the Bath; Edward Harris Greathed, Companion of the Most Honourable Order of the Bath, a Colonel in our Army, William Farr, M.D., James Ranald Martin, Esquire, and John Sutherland, M.D., greeting:

WHEREAS it hath been humbly represented to Us that, considering the great importance of maintaining and improving the Health of all ranks of Our Army serving in India, it is expedient that certain Inquiries should be made:

NOW KNOW YE, that We, having taken into Our Consideration the Premises, do hereby order and direct you, the said Sidney Herbert, Sir Robert John Hussey Vivian, Sir Proby Thomas Cautley, Thomas Alexander, Edward Harris Greathed, William Farr, James Ranald Martin, and John Sutherland, to inquire, firstly, into the Rate of Sickness and Mortality, and Invaliding among Our Troops, both of the General and Indian Services, in all Stations throughout India and its Dependencies; and into the class of Diseases from which such Sickness and Mortality arise.

AND, further, We do order and direct you to inquire into the Causes of such Sickness and Mortality; whether as relates to Climate, Locality, state of Barracks, Drainage, Water Supply, Diet, Drink, Dress, Duties, or Habits of Troops.

AND, further, We do order and direct you to inquire into what existing Stations are unhealthy, and to indicate how such Unhealthiness may be removed, if possible, and the nature of the Sanitary Improvements required.

AND, further, We do order and direct you to inquire into the subject of Healthy Positions generally, with the view of recommending the most healthy for future Occupation, and of ascertaining

whether healthy Stations may not be found within moderate Distance of such existing unhealthy Stations as may be of Political or Military Importance; also into the general subject of Sanitaria and Hill Stations, with the view of pointing out the most healthy Positions on them.

And, further, We do order and direct you to inquire as to the best Construction of Barracks, Huts, Hospitals, and Tents for India.

And, further, We do order and direct you to inquire into the present Regulations or Practice for preserving the Health of the Troops, and enforcing Medical and Sanitary Police.

And, further, We do order and direct you to inquire into the present Organization of the Army Sanitary and Medical Service.

And, further, We do order and direct you to inquire as to the Practicability of establishing a general system of Military Statistics throughout India, and to ascertain whether any, and what Means exist, of comparing the Diseases and Mortality of the Troops with those of the Civil Population, English and Native.

And, We do further command and require you to report what Changes you may consider it expedient to make in the present Practice, with respect to any of the Subjects above-mentioned.

And, it is Our further will and pleasure that you, or any Five or more of you, do obtain Information touching the Matters aforesaid, by the Examination of all Persons most competent, by reason of their Knowledge, Habits, or Experience, to afford it; and also by calling for all Documents, Papers, or Records, which may appear to you, or any Five or more of you, calculated to assist your Researches and to promote the formation of a sound Judgment on the Subject, and that you, or any Five or more of you, do report to Us, under your hands and seals, your several Proceedings by virtue of this Our Commission, together with your Opinions touching the several Matters hereby referred for your consideration.

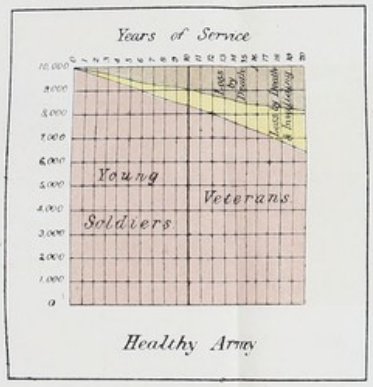
Given at Our Court at St. James's, this Thirty-first Day of May, in the Year of Our Lord One thousand eight hundred and fifty-nine, and in the Twenty-second of Our Reign.

By Her Majesty's Command.

(Signed) STANLEY.

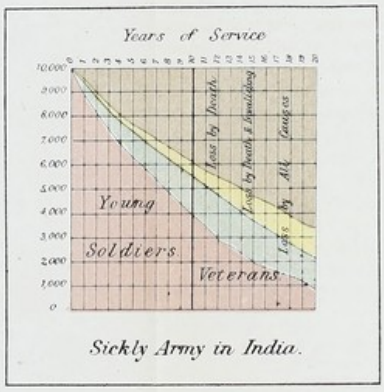
DIAGRAMS — SHOWING THE LOSS OF STRENGTH IN THE ARMY AT HOME, AND IN THE EUROPEAN ARMY IN INDIA BY DEATH, BY DEATH AND INVALIDING AND BY DEATH, INVALIDING AND ALL CAUSES.

I. Representing the Army at Home if the Mortality were the same as it is in the Male population of England at corresponding Ages.



Healthy Army

II. Representing the European Army in India.



Sickly Army in India.

Note *The dark parts of the Diagrams represent the Areas of the Graveyards filled by the two Armies in the same time, under the assumed conditions.*

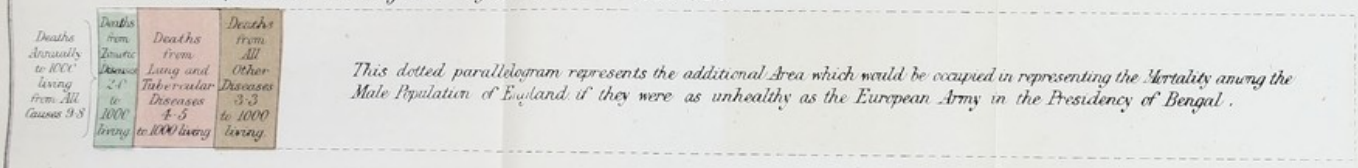
The Force 166,910 represented by the Red Area in Diagram I. is assumed to be maintained by 10,000 Annual Recruits, which if there were no loss by Death or by Invaliding would sustain a force of 200,000 men represented by the whole of the square. The loss of Strength shewn in Diagram I. is equal to 33,090 or 17 per Cent, in Diagram II. to 88,815 or 44 per Cent if no other loss were sustained than by Death and Invaliding. The Dark Area represents the loss of Strength by Death. The Dark and Yellow Areas represent the loss of Strength by Death and Invaliding. The Dark, Yellow, and Blue Areas in Diagram II. represent the loss of Strength by All Causes. It will be borne in mind that many of the Invalided die soon after leaving the Army.

10,000 Annual Recruits in Diagram I. would sustain a force of 166,910. In Diagram II. 10,000 Annual Recruits would sustain a force of 111,185 if there were no loss from any other Cause than Death and Invaliding.

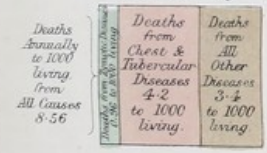
Each of the 200 small parallelograms represents 1000 men.

DIAGRAMS — REPRESENTING THE RELATIVE ANNUAL MORTALITY FROM ALL CAUSES, ZYMOTIC DISEASES, LUNG AND TUBERCULAR DISEASES AND OTHER DISEASES IN THE MALE POPULATION OF ENGLAND AGED 15-45, IN THE INFANTRY OF THE LINE SERVING AT HOME, AND IN THE EUROPEAN ARMY IN THE PRESIDENCY OF BENGAL.

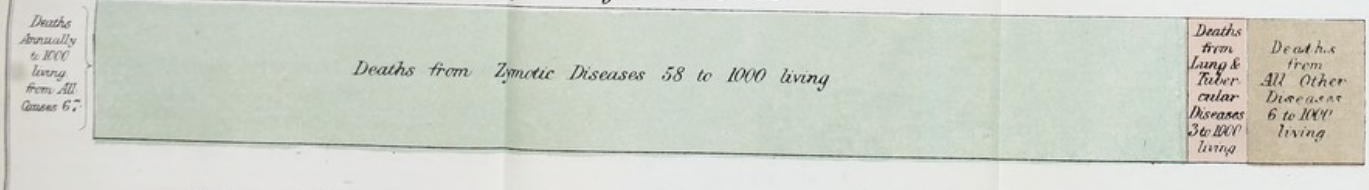
I. Male Population of England aged 15-45 — 1848-54.



II. Infantry of the Line serving at Home — 1859-61.



III. European Army in the Presidency of Bengal — 1830-45.



The Lung and Tubercular Diseases comprise all those included in the Tubercular and Chest Diseases (exclusive of Heart Diseases) of the Classification adopted by the Registrar General of England.

Diagram N°3. is constructed from a table showing the Diseases of the European Forces in the Presidency of Bengal for the 16 Years 1830-45.

REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY.

MAY IT PLEASE YOUR MAJESTY,

WE, the Commissioners appointed to inquire into the sanitary state of Your Majesty's Army serving in India, humbly present to Your Majesty the results of our investigation, which we do in this our Report, as follows:—

The inquiry in which we have been engaged has been one of unusual extent and duration, and from its nature has led to considerable delay in preparing our Report. We had, in the first place, to lay the foundation for our inquiry by an elaborate examination of the available statistical and sanitary documents in the India House. In doing so it was perceived at the very beginning that we could not arrive at our object by taking oral evidence only, and that it would be necessary to carry out a preliminary local inquiry at all the Indian stations before a true estimate could be formed of what were the real conditions of the problem with which we had to deal. With this view a series of printed questions was drawn up and sent to all the stations to be there replied to and signed concurrently by the commanding, engineering, and medical officers. We had to await the results of this part of the inquiry; and as on some important statistical points the replies from two Presidencies were incomplete, we called for further information, which has not yet been received by us. This, together with other engagements of members of the Commission, has led to considerable but unavoidable delay, which we are grieved to say has been increased by the losses which the Commission has sustained since its first meeting. The late Lord Herbert, who was our first Chairman, was compelled by official occupation, and latterly by declining health, to suspend the meetings for some time. Previous to that period, Sir Robert Vivian had been obliged by his other duties to resign as member of the Commission, and we had further to deplore the death of Mr. Alexander, the late Director-General of the Army Medical Department. To supply these losses, Dr. Gibson, the present Director-General, and Colonel Durand, since called to India, were added to the Commission, and Lord Stanley consented to succeed Lord Herbert as Chairman.

We have thought it necessary to make this statement to account for the lengthy period which has intervened between the date of Your Majesty's Commission and the date of this Report.

An inquiry extending over so large an area, and including so great a multiplicity of details, many of them of a minute character, has been necessarily voluminous and expensive; but the evidence which it has called forth appears to us to be so important, not only

to the interests of troops serving in India, but to those inextricably interwoven with them of the native population, that we have not scrupled to publish it for official use, partly for the purpose of spreading information, and partly in order that the correctness of the statements made by us might be fully sustained by authority.

Appended to the Report, we have given a précis of the evidence; and, separately, the oral evidence,* with some important addenda made to it by the witnesses, an abstract of all the stational reports,† and a valuable paper of comments on these reports, contributed, at the request of the Commission, by Miss Nightingale.

P. 345.
P. 297.

The medical statistics for the troops of the late East India Company, and also for those of the Royal Army (the latter prepared at the Army Medical Department), which follow,‡ have been drawn up from the best available data, supplied partly from India, partly by His Royal Highness the Commander-in-Chief, and by the Secretary of State for India. These, together with a paper on the geographical distribution of Indian climates prepared at our request by Mr Glaisher, contain the main statistical facts of the Inquiry. Involving a wide range of subjects, our researches have been minute, and the evidence by which our conclusions are borne out is necessarily voluminous. But we believe that the abstracts referred to contain the substance of all the facts in such a form as to render reference to the evidence almost needless, except for the purposes of verification and more minute analysis. It has been our object to present a large mass of facts and detail within as limited a compass as the nature of the questions we have discussed allowed.

In dealing with the evidence we have considered it best to arrange the facts it contains in distinct divisions, beginning with the statistics of mortality and disease. Under this head we have given,—

The strength and distribution of the army in India.
The total mortality among British troops, and at different ages and periods of service.
The annual waste of life in each year of service.
Nature of the diseases occasioning the mortality and the loss of efficiency from sickness.

We next give an estimate of the cost of placing the soldier in India, and the pecuniary loss occasioned by the present death and sick rate.

This discussion is followed by a statistical estimate of the mortality among native troops, among natives, and among Europeans and mixed races in India.

Following on this general statistical investigation we next give

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* The evidence, &c. is set out at length in a separate folio volume, printed for official use, and the figures here placed in the margin refer to the page or number of question in such folio, and in the abstract of evidence in this volume.

† These reports from Indian stations given in full form a second folio, or "Appendix to Evidence."

‡ Page 527, vol. I, folio edition.

the results of our inquiries into the mortality of particular groups of stations.

Having in this manner arrived at the facts regarding mortality and disease, we next proceed to examine into the influences affecting the health of European troops, as these are described in the evidence and stational reports.

Under this part of the inquiry we have included a general discussion on the topography and climate of India,—

The sanitary condition of stations, towns, and bazaars.

Drainage and water supply.

Construction of barracks, together with the state of their ventilation, cubic space per man, ablution and bath accommodation, cook-houses, latrines, &c.

Accommodation for officers and married soldiers.

Having considered the questions arising out of the soldier's barrack accommodation, we proceed to discuss the influence of his diet, dress, and duties. Next the very important subject of intemperance and its concomitants in their influence on health and efficiency, and the amount and kind of occupation and recreation provided for the soldier to fill up his spare time.

This is followed by an Inquiry into the state of the hospital accommodation, including the questions of construction, ventilation, cubic space, drainage, water supply, hospital conveniences, and attendance.

The very important question of hill stations follows next in order.

And, lastly, the sanitary condition of native lines and hospitals.

Having completed our survey of the causes of sickness and mortality, we consider the present state of sanitary administration in India with the improvements required to enable the causes of disease to be dealt with, and we conclude, after a recapitulation of the leading results of the inquiry, with the recommendations we have to make for improving the health of troops serving in that part of the empire.

In conformity with this arrangement of subjects, we proceed, first, to discuss connectedly the facts which in this inquiry admit of numerical analysis. STRENGTH AND DISTRIBUTION.

STRENGTH AND DISTRIBUTION OF THE ARMY IN INDIA.

The British Army consisted of 227,005 officers and men on April 1st, 1861; and 82,156 of them belonged to regiments in India at that date; 144,849 to regiments at home or in the colonies. The strength of the regiments serving in India was 94,829 in the previous year. Horse Guards' Return, dated 29th July 1862.

Thus a large proportion of the regiments is in India; and a still larger number may be called to that part of the empire in great emergencies.

Four regiments in eleven were serving there; so, should those proportions be maintained, and every regiment go in its turn, it

STRENGTH AND DISTRIBUTION.

will be exposed ten years in every 27½ years, or four years in eleven, to Indian influences. But as some corps never go to India, the service will fall more heavily on the rest.

The full establishment of a royal regiment in India was 1,119,* including 41 officers, 138 non-commissioned officers and drummers, 940 privates. And of this strength about 220 of each regiment in India figured in the depôts at home.

Horse Guards' Return.

The distribution of the army at the latest date (April 1862), we will now give from the returns, including for Bengal the non-commissioned officers and men only.†

At this date some of the changes resulting from the incorporation of the Indian forces in the Queen's army had been carried out, and the European officers in the return amounted to 3,962, the non-commissioned officers and men to 70,489 ; the native officers and men to 108,382, exclusive of 11,652 men in the Punjab local force, and of numerous police corps which have been created in all the provinces.

In Bengal, the North-west Provinces, and the Punjab, that is, in the territory filling the vast plain of the Ganges and of the Five Rivers, from Calcutta and Assam to Peshawur, a force of 85,966 men were stationed, consisting of 46,290 Europeans (officers, 2,160), and 39,676 Indians.

The Presidency division extends over the whole of the populous delta of the Ganges, from the Dhumrah river to Darjeeling in the Himalayas between Nepal and Bhotan, and along the Brahmapootra to the extremities of Assam. The military force consisted of 3,593 Europeans and 6,047 natives; namely, 1,539 Europeans and 624 natives at Fort William and Alipore, covering Calcutta; 580 Europeans, 708 natives at Barrackpore ; 413 Europeans at Raneegunge, 297 at Berhampore, and 319 at Dacca. The Europeans at other stations were few ; a corps of 1,088 natives was in Assam. The Benares division consisted of 3,390 Europeans, and 3,198 natives; 1,075 of the Europeans were stationed at the plateau station of Hazareebaugh, 680 at Dinapore, 678 at Benares, 406 at Goruckpore, and the residue at four other stations. This populous district, by the side of the independent state of Nepal, lies around the Gunduck, and the Gogra on the north, and the Sone on the south of the Ganges, which here receives their waters.

The Saugor district, in the midst of small feudatories, has 2,243 Europeans and 4,746 Indians; of the Europeans, 874 are at Jubbulpore, and 848 at Saugor. In addition here are two native corps from the Madras presidency.

In proceeding up the Ganges, the Oude and Meerut divisions, with the Gwalior on the left, and the Rohilcund division to the right, extending to the Himalayas, consist of a force of 18,987

* See Colonel Baker's Paper, No. 52, Appendix to Report of Commission to inquire into Organization of Indian Army.

† There is a great want of uniformity in the returns of all the Presidencies. And for various purposes it has been necessary to use returns of different dates, sometimes supplied by the Adjutant-General, and at others by the India Office.

Europeans and 13,391 Indians. 1,302 Europeans, 1,351 Indians, are stationed at Gwalior; 738 Europeans and 413 Indians at Jhansi. Oude is occupied by a strong force of Europeans, of whom 1,386 are at Allahabad, 1,294 at Cawnpore, 2,085 at Lucknow, 597 at Roy Bareilly, 1,256 at Fyzabad, 799 at Gonda, and 610 at Seetapore. Only 2,848 natives of India are in Oude; and 554 Europeans, 302 Indians, in the Rohilcund district, are at Shahjehanpore; 1,074 Europeans are at Bareilly, 406 at Moradabad, 241 at Nynee Tâl. STRENGTH AND DISTRIBUTION.

Of the troops in the Meerut division, 578 Europeans are at Futtyghur, 1,206 at Agra, 506 at Muttra, 1,165 at Delhi, 2,094 at Meerut, 632 at Roorkee (the head quarters of the Ganges canal operations), and 156 at Landour, one of the lofty hill stations.

4,874 men of the European force, and 2,524 of the native force, are in the Sirhind division, between the Jumna and the Beas; namely, 1,840 Europeans at Umballa, 263 at Jullundur, 220 at Phillour; and in the high hill districts, 630 at Dugshai (16 miles from Simla), 76 at Kussowlie, and 935 at Subathoo.

The Punjab is held by 11,043 Europeans and 9,770 of the native army. At Umritsir there are 621 Europeans, 501 natives; at Sealkote, 1,471 Europeans, near the Chenab, flowing from Gholab Sing's dominions, 1,266 at Lahore, 819 at Ferozepore, and 1,171 at Mooltan. At the three latter stations, 3,221 men of the native army are located.

The Peshawur district of the Punjab, lying against the Khyber Pass and Afghanistan, is held by 157 Europeans at the station on the Jhelum flowing from Cashmere; 1,438 at Rawul Pindi, 214 at Attock on the Indus, and 711 at Nowshera, near Peshawur, which is itself occupied by 2,027 Europeans, and 2,849 natives,

The East India railway runs through the Bengal military divisions, and, with that of the Punjab, connects them all from Calcutta to Lahore on one strategic line, which is prolonged by the grand trunk road to Peshawur.

Another railway line extends from Allahabad on this base to Jubbulpore and Bombay, nearly parallel to the remoter line going from Lahore to Mooltan.

The European forces of this command are stationed, with few exceptions, at the bottom of the Ganges plain, near the chief cities on the rivers.

Descending the Indus, the Bombay presidency is entered through the Sinde division, where 293 Europeans are stationed at Hyderabad, the summit of the delta of the Indus, and 1,219 at Kurrachee, with 841 natives at the former, 773 at he latter station. There are 83 officers, 1,512 Europeans, and 4,155 natives, including the frontier brigade in Sinde, lying between the Suliman range, with the Belochs on the north-west and the desert on the south-east.

The force in all the Bombay presidency,—including 465 Europeans, 2,380 natives in the presidency division,—consists of 12,198 Europeans and 29,681 natives. They are commanded by 852 officers.

STRENGTH AND DISTRIBUTION.

The northern Bombay division, extending over the Cutch and Guzerat from Sinde to Poona, has 908 Europeans, at Deesa on the Bunnass, 302 at Ahmedabad, 60 at Surat, and 46 on Mount Aboo, making, with the troops at two more stations, 1,318 non-commissioned officers and men, besides 5,940 natives, at the same stations, at Baroda, Bhooj, and elsewhere.

The Mhow division, of 3,478 Europeans and 4,527 natives, occupies a central territory intersected by the Aravulli and Vindhya ranges of mountains, whose waters flow into the Nerbudda and the Chumbul. The territories of Holkar, Sindia, and the warlike Rajpoots lie around the stations, of which Mhow, near Indore, is held by 1,680 Europeans, Nusserabad by 1,060, Neemuch by 564, and Ajmeer by 61. The railway from Agra to Bombay goes through this country, south of the desert, but parallel with the distant Indus.

The Poona division carries us further into the tropics, but higher over the Deccan and the Ghauts; it surrounds the presidency, and holds the ancient seat of the Mahratta power with 235 officers, 3,323 European non-commissioned officers and men, and 6,515 natives. Of the Europeans, 1,850 are at Poona, where the Peishwa resided, 438 at Kirkee, in its vicinity, 724 at Ahmednuggur, 215 at Sattara.

The Belgaum division, further south, but north of Goa, consists of 98 European officers, 1,132 men, and 3,794 natives; the Europeans being at Belgaum, the native force, with their European officers, at Dharwar, Kulladghee, Kolapore, and Vingorla.

The presidency of Fort St. George, Madras, had under its command 14,161 Europeans, besides 950 European officers, and 39,025 native officers, non-commissioned officers, and rank and file.

It had two native corps in the Saugor division, which has been before referred to, and is also occupied by troops of the Bengal force.

The Nizam, in his dominions of nearly 100,000 square miles, and more than 10,000,000 inhabitants, in the centre of the Deccan, has a considerable military array, consisting of an auxiliary force under British officers, paid by him, irregulars, and dependants of Ameers.

The British subsidiary force of 183 officers, 3,161 Europeans, 4,272 Indians, occupies cantonments at Secunderabad, near his capital, at Jaulnah, and other stations. The Nagpore force of 86 officers, 1,603 Europeans, and 2,484 native officers and men, is at Kamptee, Hoosingabad, and several detached posts, in a country which was, like Hyderabad, recently under the Rajah of Berar, and lies between the Nizam's dominions and Bengal.

77 officers, 906 Europeans, and 3,445 native officers and men occupy the ceded districts which were detached from the Nizam's territory, south of the Kistnah, by treaty. 57 officers and 902 Europeans are at Bellary.

The Northern division, chiefly of natives, is diffused on the coast country, extending from the mouths of the Kistnah over those of the Godavery and the Mahanuddy to the river Dhumrah, which separates it from Bengal. The division consisted of 65 European

officers, 106 men and non-commissioned officers, 5,929 native officers and men. STRENGTH AND DISTRIBUTION.

The Mysore division of 229 European officers, 3,486 non-commissioned officers and men, and 7,354 native officers and men, was stationed chiefly at Bangalore, at Mangalore and Cannanore, at Mercara, at Hurryhur on the Tumbudra, and at the French Rocks. The Europeans are chiefly at Cannanore, on the Malabar coast, and at Bangalore, which is 3,000 feet above the sea level, and joins Madras by a railway. Seringapatam, Hyder Ali's capital, was abandoned on account of its insalubrity.

The Neilgherry hills are on the borders of the Mysore, and of the Southern division, which extends over all the southern extremity of the peninsula. 59 European officers, 691 men, and 3,586 native officers and men are in the districts of Trichinopoly, Palamcottah, and Quilon. Trichinopoly is above Tanjore, the fertile delta of the Cauvery, on an extensive open plain.

The Central division of 112 officers, 2,101 non-commissioned officers and men, and 4,076 native officers and men, occupies the stations around Madras. The Europeans are at Fort St. George, St. Thomas's Mount, and Palaveram, from which numerous detachments are sent. Two native corps are at Vellore and Arcot.

Since the Burmese wars (1826 and 1852) the province of Pegu, east of the bay of Bengal, in addition to Arracan and Tenasserim, is British territory; and the Pegu division consists of 85 European officers, 2,096 European men, and 4,561 native officers and men. The Europeans are at Rangoon, in the delta of the Irawaddy, at Thayet Myo above Prome, on the same river, and at detached posts; some of them on the Madras side of the bay of Bengal. The native corps are at Tonghoo and Moulmein.

At the extremity of the Malay peninsula, native corps of the Indian army, consisting of 18 European officers and 1,378 men, occupy the Prince of Wales's island and Singapore, which command the Malacca straits, and afford the protection of the British flag to the surrounding people and to the commerce of China.

A native corps of 14 European officers and 938 men, from the Bombay presidency, was in China; and the same presidency returns a small native force of 342 in the Persian Gulf, at Bushire, at Bussorah, where there were factories, and on marine duty.

A brigade at Aden, on the way to Europe by the Red Sea, consisted of 29 European officers, 584 men, and 1,053 Indian officers and men.

India has been the centre of military operations carried on in the Red Sea, in the Persian Gulf, and in the China seas; and the army, now incorporated with the army of the Empire, exists for its defence. This has necessarily to be borne in mind in the distribution of the Indian forces.

Mortality of the British Troops in India.

Having given this brief sketch of the present distribution of troops throughout India and its dependencies, we next proceed to show what is the rate of mortality and the effect of this on the efficiency and on the cost of the Indian army. MORTALITY OF BRITISH TROOPS.

Mortality of British Troops.

The medical reports, special investigations of the casualty rolls which we have had made, and a great variety of returns, supply the materials for determining the mortality of the European non-commissioned officers and men in the various arms and in the presidencies.

In a spirit of providence the servants and officers of the late Company established funds for the sustenance of widows and orphans; but without adequate data, and hence it has been necessary to submit their experience to the investigation of several actuaries in London, who have at various periods reported on the mortality of the members and of the services. These reports exhibit the mortality of Indian civil servants, of military officers, of wives, widows, and children.* From another source we are able to follow the Indian officer home, and to determine his life-time after passing through the perils of India. With the non-commissioned officers and men we can now, for the first time, deal in the same way.

The variations of the rate of mortality among men depend on two great classes of causes; the first class inherent in the organization itself, the second external. Thus, under similar circumstances, the force of life declines, the mortality per 1,000 increases year by year after the age of 15. Among females, never exposed to the risks of war or of dangerous occupations, it is 7·65 at the age of 20; 8·94 at the age of 30; 9·98 at the age of 40; 11·92 at the age of 50; 21·62 at the age of 60; 49·92 at the age of 70; and 118·66 at the age of 80 in the healthier districts of England and Wales. The increase of mortality up to the age of 50 is at the rate of about 1½ per cent. for every year of age, or 16 per cent. for 10 years; so that if the rate of mortality is 10·00 at the age of 40, it becomes 10·15 at the age of 41, and nearly 12·00 at the age of 50. After the age of 50 the mortality increases annually at the rate of 8·7 per cent., and is doubled in every 8¼ years of age.

Sex, and perhaps race, as well as age, are other inherent elements affecting the rates of mortality. Each age or sex is subject to a mortality which may be called natural in the present state of mankind; but that natural mortality is everywhere augmented by bad habits and unfavourable conditions. The natural standard is therefore undetermined; but the ascertained rates of mortality actually prevailing among large bodies of men will serve temporarily all the practical purposes of the exact natural standard.

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* We have been able to use some of these reports by Griffith Davies, and Neison, which have been published for private circulation; and have particularly to thank Mr. Samuel Brown for the MS. results of an investigation into one of the funds, bringing down the inquiry to the latest times. Major-General Hanyngton has placed a valuable table at our disposal. A valuable series of statistical returns have been collected by Sir Ranald Martin in his work on the Influence of Tropical Climates. The papers of Dr. Chevers, the digest of the vital statistics of the armies of India by Dr. Ewart, and other publications, show the interest that the medical officers of the Indian army take in the subject. The evidence of Sir Alexander Tulloch, Dr. Balfour's tables, and the second army report have been consulted. We have relied much upon the tables of sanitary statistics (in the 1st vol., folio edition) which have been procured for the Commission.

Mortality of British Troops.

Now the mortality of men of the soldier's age in the healthy parts of England and Wales is such that, on an average, 8 die annually to 1,000 living.*

Recruits for India undergo careful examination; and when soldiers are attacked by consumption, or any disease that is not soon fatal, they are invalided. So that their recorded mortality in peace, under such conditions as can be commanded for the army at home, should not exceed that experienced in the healthy districts of England, which, as regards their salubrity, are by no means perfect models.

Half the population of England and Wales is concentrated in town and city parishes, under many unfavourable conditions, and the annual mortality of Englishmen of the soldier's ages is 9 in 1,000.

The mortality of men of the same ages in the unhealthiest towns of England, and in the unhealthiest trades, is at the rate of 12 in 1,000.

Thus the mortality varies in different cases; and as it rises from 8 to 9 and 12, unfavourable sanitary conditions are discovered accounting for every degree of increase. The same principle holds in the mortality of the British army at home, which was at the rate of 17 per 1,000 annually, and is now declining in proportion as the causes of disease are abolished or mitigated.

The mortality of the non-commissioned officers and men serving in the British army abroad in the four years 1857-60 was at the rate of 41 in 1,000; of the officers the mortality was 30 in 1,000.†

The annual mortality of officers serving at home and abroad was 17, of non-commissioned officers and men 33 in 1,000 during the years 1839–53, of European peace.‡ Sir Alexander Tulloch gave in his evidence a series of War Office returns of the strength, deaths, and mortality of the Royal army in India during 39 years, 1817-55, from which it appears that the mean strength in the three presidencies was 20,332, and the deaths 55,584, so the annual rate of mortality was 70 per 1,000. The Mahratta, Pindaree, Burmese, Afghan, Sinde, Sutlej, Punjab, and Chinese campaigns account, according to his estimate, for 10 of the 70 annual deaths.§

Those who are conversant with military statistics are well aware of the difficulty of obtaining results at once exact and precise. This difficulty is increased in India, and the necessary calculations are further complicated by the distribution of European officers among the native corps, by the mixing up of officers and men, or of the Royal army with that of the late Company, or of men at home in depôt with men in India, and by the confusion of invaliding from disease with the discharge of soldiers whose terms of

* 7·7 per 1,000 is the exact proportion. See Tables by Dr. Farr in Appendix to Report on Sanitary Condition of the Army, p. 521, and Evidence, p. 12.

† Registrar-General's Report for 1860.

‡ Appendix to Report on Sanitary Condition of Army, p. 521.

§ See p. 319 of Evidence, folio edition, and p. 283 *post*; also pp. 178–186 of Evidence before Commission of Inquiry into the Organization of the Indian Army, 1859.

Mortality of British Troops.

service have expired. The medical returns for some time appear to have included only the deaths in hospitals.

After carefully examining all the documents at our disposal, we selected for analysis the nominal rolls of strength and casualties at the India House relating to the late Company's European troops. The collection of annual casualty rolls at the India House was "compiled upon the principle of accounting for every man "becoming ineffective in the year." Verified by the signatures of the commanding officers and adjutants of corps, the rolls are perfectly intelligible and substantially correct; they have been, therefore, analysed elaborately for the purposes of this inquiry. The troops of the Company, unlike the Royal army, served only in India, where they remained until death, or until they returned home.

The deaths in the 57 years 1800-56 among all the Company's non-comissioned officers and men, including invalids in India, amounted to 40,420, out of an aggregate of 588,820 years of life, obtained by adding up the average annual strength in those years; so the annual rate of mortality has been 69 in 1,000 during the present century.

The mortality rate was as high as 134 in 1804, in the first Mahratta war, and it was as low as 41 in 1852. It was high again in the years of mutiny, and it has been subsequently lower than the Indian standard. From the rate of 55 in 1770-99, the rate rose to 85 in the 30 years 1800-29; and the mortality fell to 58 in the 27 years 1830–56; so that the death-rate of the British soldier since the first occupation of the country down to the present day has oscillated round 69 per 1,000.

If the mortality is set down at 69 in 1,000, it follows that, besides deaths by natural causes, 61, or taking the English standard, 60 per 1,000 of our troops perish in India annually. It is at that expense that we have held dominion there for a century; a company out of every regiment has been sacrificed every 20 months. These companies fade away in the prime of life; leave few children; and have to be replaced, at great cost, by successive shiploads of recruits.

The Rates of Mortality at different Ages in India.

Mortality at different Ages.

To determine the rate of mortality among British troops in India, of different ages, as well as of different terms of service, the returns of the 10 years 1847–56 have been used. The mortality in the Bombay and Madras presidencies was much lower in those years than it had been previously; and the Table includes the non-effectives—invalids, pensioners, and men on the town major's list—at advanced ages. The mortality of war in India is, therefore, relatively unimportant; and we can appreciate the effects of the ordinary causes of mortality on men of all ages, from 10 to 75.

The mortality of boys, and of all under the age of 20, is much lower than it is ever afterwards; and other evidence shows that young men in favourable circumstances, and children with proper care, suffer less than adults in India.

Mortality at different Ages.

The mortality per 1,000 at the age of 20–25 is high (56·4); at the next age (25–30) it is less (48·8); and then it rises gradually to the age of 40; at the age of 40–45 the mortality is again higher (61·6) than it was at the earlier age of 20–25; the mortality afterwards falls.

See Table 11 [p. 136 *post*].

It is worthy of remark, however, that the excess of mortality in India is nearly the same at all the seven quinquennial periods of age from 20 to 55, except at the first and the fifth, when the recruits join and leave their corps in greatest numbers. This points to the influence of the term of service, which we have also investigated, and seems to justify the inference that the fatal causes in operation produce nearly the same fatal results in India at all the ages, from 20 to 55, among men exposed to the same extent to their influences.

From the age of 55 the excess grows less, and at 70 and upwards the old men die nearly at the same rate in India as in England. Although the facts at the extreme ages are few, it is evident that the men of the middle ages are, under present circumstances, the greatest sufferers.

From the rates of mortality we have had a life table constructed, and the mean duration of life, as well as the value of annuities dependent on soldiers' lives in India, can be deduced. These mortality and actuarial tables have been prepared by Dr. Farr.

Tables 12 and 22–25 [pp. 137, 148–150 *post*].

The mean after-lifetime, or, as it is sometimes called, the expectation of life at the age of 20, is 17·7 years in India, 39·5 years in England; so life is shortened by 21·8 years.

Table 22.

An annuity is at the age of 20 worth 12 years' purchase on a soldier's life in India, or less by 10 years than an annuity on an average life at home.

Table 25.

What is the effect of residence in India on the after-lifetime of men who return to England at the age of 40? We have the means of determining this effect by comparing the after-lifetime of the Indian Table with that of the pensioners who have served in India.*

The after-lifetime at the age of 40 is 15 years by the Indian Table, 22 years by the Table of Indian pensioners resident for the greater part in England, and 26 years by the English Life Table.

Influence of Term of Residence in India on the Rates of Mortality.

Influence of Residence on Mortality.

This involves the important question of acclimatization. In the Table 4 the facts for 1847–56 are arranged with reference to the soldiers' years of service; and it is evident that the mortality (65·2) during the first year of residence is higher than it is subse-

* The Life Table for the Indian pensioners has been deduced from the facts supplied by Mr. Robinson in the Appendix to a War Office Report. The great irregularities observable in the probabilities of living a year, as given by Mr. Robinson, are evidently accidental, and are partly referrible to the state of the pensioner when he is placed on the list. The Table is, therefore, graduated by the method of differences applied to the logarithms, so as to give a uniform series.

INFLUENCE OF RESIDENCE ON MORTALITY.

Table 4 [p. 133 *post*].

quently. It decreases gradually, and becomes sensibly less in the fifth year, 44·1; it then rises slowly, and is 47·0 at the second quinquenniad (5–10); 52·8 at the third. The reduced number, 43·0, at the fourth period of residence (15–20 years) arises probably from the elimination of the sickly by invaliding, which then becomes active (6 per 100). This, however, although it takes away a fourth of the numbers annually, does not prevent the mortality, partly from advancing age, rising to 62·5 per 1,000 in the last periods of service.

It is evident that when men are exposed to the operation of very unhealthy places, many of the weak are cut off at once; while of the survivors some are exceptionally left capable of resisting the local poison, and others are so enfeebled by its influence that they rapidly succumb. These two sets of causes in conflict are nearly in equilibrium in India, so that the mortality always remains high; and if acclimatization in the ordinary sense takes place, it is at advanced ages. The causes which destroy Englishmen in India, like arsenic or any other poison, do their fatal work in every year of age and of residence; and indeed the zymotic agents which produce cholera, dysentery, liver disease, diarrhœa, and fever in all its forms comport themselves like organic poisons.

No. 17, p. 539, fol. ed.

This view is confirmed by a new combination, in which a Table shows the mortality in different years of service among those entering India early and late in life. But, upon the whole, early entry into India appears to be an advantage, not only at first, but in after-life.

Tables 1 to 39, pp. 531–575, fol. ed.

It is further evident, from a comparison of the mortality in the several corps and presidencies, that the mortality in India depends on the intensity of zymotic poisons, and the time at which the men are exposed to the influences rather than on the incident that they have resided one, two, ten, or more years in the climate of the tropics.

LIVES WASTED IN INDIA IN EACH YEAR OF SERVICE.

LIVES WASTED IN EACH YEAR.

It is possible to exaggerate the waste of life in India, and this has sometimes been done by assuming that the reduction in the numbers is due to the deaths alone in such cases as the following: "Of the troops which Sir Abraham Shipman brought with him "to Bombay in 1662, there remained in 1664 only 93 out of 500." "At the time of Major Kilpatrick's death, in 1757, only 5 of the "250 soldiers who accompanied him from Madras in August of "the previous year survived him."* A return handed in by Brigadier-General Russell throws some light on the reductions. Out of the 1,064 non-commissioned officers and men of his regiment (the 84th) who landed at Moulmein in 1842, only 93 landed in England on its return in 1859; thus the numbers were reduced from 1,064 to 93 in the 17 years, and the regiment was almost

Evidence, Addendum, 3900, ol. ed.

* Moore, Health in the Tropics, pp. 50, 51.

completely renewed in India. It was joined by 1,248 recruits, and the deaths were 817. Now had the mortality been uniformly 5 per cent. per annum (and the witness said it had been 3 per cent. for 14 years prior to 1857), the original numbers would only have been reduced in this case, by death, to 455. There are, besides death, many casualties which reduce the corps in India, and we shall shortly advert to them. LIVES WASTED IN EACH YEAR.

Again, the author of the useful book on the "Vital Statistics of "the Anglo-Indian Armies," "demonstrates" that the European army in India has hitherto disappeared in about 13½ years. This follows, he infers, from the fact that the mortality and invaliding are at the rate of 7·4 per cent., while in reality 1,000 men would only be reduced, at that rate, to 368 in 13½ years.*

We have the means of determining from the returns of the 10 years the casualties by death, by invaliding, and by other causes, in the late Company's European troops; and the results are shown in the Tables 5 and 6. The Table 6 has been constructed from the facts in Table 5 by the same methods as are employed in constructing life tables, for there is no simpler method of obtaining accurate results.

It will be observed that 100,000 men are reduced to 9,604 in 20 years of service, by 90,396 casualties of every kind; 40,447 by deaths in the service, 14,627 by invaliding, 3,558 by purchasing their discharge, 8,972 by the expiration of their terms of service, 968 by promotion, 5,724 by transfers to the town major's list, 13,976 by transfers to other corps, 1,818 by desertion, and 306 by other causes. The half of the deaths (21,499) takes place in the first five years; and the numbers invalided increase slightly in each quinquennial period. Table 6 [p. 134 *post*].

The decrement, year by year, of the force in India is shown in the annexed Table 7, in which it will be seen that 1,000 effectives are reduced to 96 in 20 years. Now, the 1,064 men of the 84th were reduced to 93 in 17 years; and this, while it agrees very closely with the tabular results, points to the fact that the Queen's regiments are reduced more rapidly than the Company's by the shorter terms for which the men enlist. [p. 134 *post*].

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* This calculation has been adopted by other writers, and its fallacy is not immediately obvious. But assuming that the rate remains uniform, and is such that out of every 100 alive at the beginning of a year, 10 will die, &c., in its course, then the numbers will be reduced to 90 at the beginning of the next year; and, if the rate remain the same, nine, that is 10 per cent. of 90, will die in the second year; but upon the hypothesis of Dr. Ewart 10 will die every year until the 100 have expired; that is, 10 out of 90 will die in the second year, 10 out of 80 in the third year, and so on until, in the tenth year, 10 die out of 10 living, that is, the deaths, instead of being uniformly 10 per cent. on the strength, will be made by this procedure at last 100 per cent., which is contrary to the hypothesis of a uniform rate. Let n be any number living at any moment, and p be the fractional proportion living a year, then np^x = the numbers surviving at the end of x years on the hypothesis of a uniform rate. In the above case $n = 100$ and $np^x = 100 \times (\cdot 9)^{10} = 35$ nearly. This accidental oversight must not deprive Dr. Ewart of the credit due to him for his useful work; which has been compiled with care. (See Digest of Vital Statistics, by Dr. Ewart, p. 20.)

LIVES WASTED IN EACH YEAR.

The mean term of service in India, immediately deduced from this Table, is 8·6 years,* and 11 recruits are required annually to every 100 men.† To maintain an army of 85,856 men, 10,000 annual recruits are required, even where the term of service is as prolonged as it was under the late Company's regulations. The recruits entering are reduced to less than half their original number in eight years; their probable term of service was, therefore, between seven and eight years.

The half of a regular army so constituted consists of men who have served less than six years, and not more than a fourth of the men are veterans of 10 years' standing, on whom the discipline and solidity of an army greatly depend

It is evident that the recruiting is more difficult, and that the losses from other causes than death are greater in an unhealthy than in a healthy army, for the invaliding, the desertion, and the discharges from all causes are influenced by sickness.

Tables 8 & 9 [p. 135 *post*].

We have constructed two other Tables, the one showing how the same number of recruits (100,000) would be reduced year after year by death alone, and the other showing the reductions by death and invaliding together.

By death alone 1,000 would be reduced in 20 years to 344; by death and invaliding to 216; by death, invaliding, and other causes, as we have seen, to 96.

Out of 1,000, by the Table 9, it appears that, if none were discharged, except by death, 656 out of 1,000 would die in 20 years; while by Table 6 it appears that out of the 1,000 only 404 die in the service; hence it follows that if the same rate of mortality rules out as rules in, 252 of the discharged will die in the 20 years out of the service.

Diagram [p. 1 *ante*].

The waste of life in India is illustrated in the diagram, where it is contrasted with the decrement of life at home.

NATURE OF FATAL DISEASES AND ATTACKS OF SICKNESS IN INDIA.

NATURE OF DISEASES.

The great endemic diseases of India, those which injure the health or destroy the life of the British soldier, are fevers, dysenteries, diseases of the liver, and epidemic cholera, which has for many years engrafted itself on the endemics of the country. Compared with these all other diseases are of minor extent and importance.

The four diseases here mentioned are almost exclusively diseases of the sultry plains of India, and when any of them are found in the elevated lands they are generally modified in degree and reduced in proportionate frequency, certain forms of bowel complaints, when the sufferers are removed from the plains to the high

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* The sum of the col. $(l_x) - \frac{l_0 + l_{20}}{2}$ divided by l_0 = the average term of service among the effective non-commissioned officers and rank and file serving for 20 years or less.

† The number of annual recruits is obtained by dividing the strength by the average number of years' service.

grounds, being the only exceptions. We shall notice briefly each of these diseases.

NATURE OF DISEASES.

Fevers.—Sir Ranald Martin states that remittent fevers are found almost everywhere throughout the East Indies, varying in their intensity and in their complications according as they occur in deltas, along marshy banks, or at the embouchures of rivers, in plains extending from the bases of mountain ranges, termed "Terrais," in partially inundated or irrigated lands, or in tracts traversed by percolating streams, or occupied by jungles, or in certain low hilly districts. The seaboard, especially where there is jungle or salt marsh, and the adjacent islands when of a jungly or marshy nature, are peculiarly pestilential, and so are often drying-up marshes and drying-up beds of rivers.

Of the various obstacles which bar the colonization of the white man in tropical regions, and of the many causes which reduce the strength of our armies there, remittent fever is the principal.

Sir R. Martin states that out of a British force of 25,431 men serving for eight and ten years respectively in Calcutta, Chinsurah, and Berhampore, all in Bengal Proper, there occurred 13,596 cases of fever; that in the healthier upper provinces of the same Presidency with diseases generally of less degrees of severity, out of an average British force of 23,731 men serving there during seven years, there occurred 14,159 cases of fever, and that throughout India, 50 per cent. of all the admissions into hospitals are from fevers, while in the Presidency of Bombay, amongst persons of all classes, castes, and countries, fever causes about 40 per cent. of the total deaths.

But besides the great prevalence, personal suffering, and immediate risk to the life of the soldier under fever, the disease entails more or less disposition to relapses, with more or less after danger, according as the original fever may have been more or less malignant in its nature. Added to these circumstances again, it is found that diseases of important organs, the consequences of malarious fevers, occasion much of the subsequent sickness, mortality, and invaliding among British troops serving in India.

Dysentery and Diarrhœa.—Next to fevers in frequency, but more fatal, comes the dysentery of India. In its causes it is intimately associated with tropical fevers, remittent and intermittent; so much so that where fevers are present dysentery is never far off. "Dysentery," says Sir Ranald Martin, "has occasionally "been found to assume a malignant character in low damp situa- "tions, so as to prove very deadly; but on removal of the suf- "ferers to elevated sites and a better air, the disease has been "rendered amenable to treatment."

He describes the dysentery of India as most prevalent in the plains and during the hot and rainy seasons. "Out of an aggregate "British force of 25,433 men of Her Majesty's army serving in "periods of eight and ten years respectively in the stations of "Calcutta, Chinsurah, and Berhampore, all in Bengal Proper, "there occurred 8,499 cases of dysentery and diarrhœa. The "climate of Lower Bengal has always been very unfavourable to

NATURE OF DISEASES.

"European health as compared to Upper India; but, making allowance for all circumstances, including the ill habits of life of the soldiery, the amount of sickness from dysentery and diarrhœa here exhibited is enormous." "In the presidency of Madras, again, out of an aggregate British force of 82,242 men serving there from 1842 to 1848, there occurred 10,531 cases of dysentery and 9,189 cases of diarrhœa, making a total of 19,720 cases of bowel disease, exclusive of cholera. It thus appears that next to the malarious fevers of India, bowel complaints are the most prevalent, while the dangers to health and to life from these last are even greater than from fevers." Sir R. Martin further states that among British soldiers 11 cases of dysentery occur to 1 amongst the native soldiery. In acute dysentery, as in malarious fevers, there is much present danger and suffering, and when the disease is not arrested at once, chronic suffering extending over years, or the prospect of death more or less distant in the hospitals, is all that remains to the soldier. The case is described by the older army surgeons as presenting "a spectacle of distress of as pitiable a kind as can be found in the history of human suffering." Invaliding and death are the last events, and most of the casualties which occur amongst sick soldiers on the voyage homewards from India are from chronic dysentery.

Diseases of the Liver.—Sir Ranald Martin states that, whether as original or secondary affections, diseases of the liver are a very frequent and very important class of diseases in the East Indies. He adds that no official returns, under special heads, afford accurate information as to the actual frequency of liver diseases; for when these last occur as complications with, or as consequences of, fever, dysentery, diarrhœa, or cholera, the cases are generally classed and numbered under the head of the primary disease. "It thus happens," he says, "that the numerical hospital returns do not yield anything like an approximation to a true estimate of the existing amount of hepatic diseases." "Acute inflammation of the liver," he states, "is essentially a disease of the hot plains; and its severity may be judged of by the fact that the chance of death is greater from one such attack than from 13 of fever of the various forms, as they ordinarily occur in India."

In acute disease of the liver the danger to life is so imminent that the case must, within a few days, terminate in a recovery more or less complete, or in death; while the chronic form of this malady, the injury to health, and the protracted distresses are very great.

He further states, that out of an aggregate British force of 211,993 men serving in Bengal from 1812 to 1832, there were 14,015 admissions into hospital on account of diseases of the liver, of which 924 died. From 1833 to 1854, out of an aggregate force of 331,775 men serving in the same presidency, there were 18,765 admissions and 1,345 deaths from liver diseases.

Epidemic Cholera.—Epidemic cholera is the most acute of all acute diseases, and, like the last mentioned, it always ends in the more or less immediate recovery, or in the death of the sufferer.

NATURE OF DISEASES.

This disease has been known to prevail as an occasional epidemic at different years, seasons, and places throughout India from 1774 to 1817; and there are authentic records of its existence in Batavia so far back as 1629. The symptoms described at the different times and places leave no doubt as to the sameness of nature of the disease, not to mention its uniform and great mortality.

But in India, since 1817, cholera has engrafted itself on the endemics of the soil, and has become a disease of annual recurrence at many of our large stations, commencing generally at the beginning of the hot season, but sometimes in the rainy and cold season. It has proved everywhere, all over the world, the same disease, with the same mortality whenever it has fastened on a congenial soil; and its great tendency is to attack populations living in low, damp, crowded, and ill ventilated situations, especially if supplied with impure water; while the proportionate mortality amongst those attacked has been about the same, whether at the lowest levels or on the loftiest mountains.

Here, however, there exists an important distinction, that while the proportionate mortality of those attacked is everywhere the same, the proportionate numbers seized in high and low situations differ most widely. Cholera and epidemic diseases in general are of rare occurrence in the elevated ranges of India, where the water is comparatively pure.

Troops, both European and native, while on the march, have been observed to become more liable to seizure by this disease, and when the attacks have occurred in cantonments after the march, it has been found that the virulence of the epidemic has been proportionate to the length of the march.

As regards the comparative mortality Sir Ranald Martin states that out of every 100 deaths of Europeans serving in the Presidency of Bombay, between 1830 and 1846, the proportions of deaths attributable to the four great endemic diseases were as follows:—

Fevers - - - -	23·054
Dysentery and Diarrhœa - -	32·441
Diseases of the Liver - -	9·597
Cholera - - - -	10·320

We have the means of comparing the deaths of soldiers from each disease in the Bengal presidency with the deaths of men from the same disease at home. The periods are for the 16 years (1830–45) in Bengal; and for the seven years (1848–54), including the two years when cholera was epidemic in England. The annual rate of mortality was 10 per 1,000 in England, and 67 per 1,000 in Bengal, of which 58 per 1,000 was by zymotic diseases. The fevers, ague, remittent and continued, killed 17 men in 1,000; dysentery and liver disease, 20; cholera and diarrhœa, 18. Delirium tremens, catarrh, syphilis, rheumatism, and scurvy were also much more fatal in India than in England. Among constitutional diseases, the deaths from phthisis, scrofula, and cancer were fewer in Bengal than in England; but these cases are of long duration, and are precisely such as are sent home on the invalid lists to die.

Vide Miscellaneous Tables, with illustrative diagrams, p. 576, fol. ed. Vol. 1.

NATURE OF DISEASES.

Of diseases affecting particular organs, apoplexy is the most fatal, and 3 deaths per 1,000 are referred to that disease, which at the age of the soldier is exceedingly rare in England. The frequent pneumonias are, probably, of a congestive character, or are like bronchitis, connected with influenza. Enteritis, phlegmon, ulcer, ileus, jaundice, and spleen diseases are either masked zymotic diseases, or their common sequels.

The deaths from wounds are most numerous in India, but these deaths and all the deaths by violence in the return are less (·8) than 1 in 1,000, and less than the deaths by violence among the civil population of England (1·0). The medical returns under the old arrangements included only the deaths in hospital, and they did not include the killed in the field, which should be added. The two series of facts in the Table are strictly comparable, and show clearly enough how much of the mortality of India is due to a few diseases, which are rendered fatal by well-known causes.

No. 1, p. 576, and diagram, fol. ed.

The fatality of these diseases to our armies in India is rendered evident to the eye in the two diagrams.

It is worthy of remark that nearly all these diseases fatal in India are accompanied by profuse discharges, with which the air, water, bedding, linen, closets, walls of hospitals and barracks become more or less infected. In a common building the *materies morbi* comes into contact with all the inmates.

In comparing the proportion of attacks of illness among British troops in India with that among men at home, we find that the East India Company formerly employed 2,461 labourers in London, and during the 10 years that observations were taken by the medical officer, 246 in 1,000 were attacked by illness annually; or each man was liable to one attack of illness of some severity every *four* years. This agrees with other observations, and includes cases of sickness of such gravity as disables artizans from following their ordinary work. In a Liverpool society, out of 1,000 members, 320 applied 400 times in the year for sick pay, and were treated by the surgeons, who also attended 350 more for slighter ailments, making 750 annual attacks of sickness, such as doctors attend to, among 1,000 members.*

Syphilis is not included in the returns of the friendly societies.

One thousand British soldiers at home experience about 1,000 attacks of sickness in the year, but in India the soldier's sickness is doubled. To one illness of the labourer, the soldier is liable to four, of at least equal severity. Thus, from a return supplied by Dr. Balfour, it appears that the 16,850 troops of the line in Bengal furnished the hospitals with 172,388 cases in the five years 1850–4, when 4,461 cases terminated fatally. A battalion of 1,000 men sent yearly on an average 2,045 cases to the hospitals; each soldier in India was exposed, therefore, to two

* See article "Vital Statistics" in McCulloch's Statistics of the British Empire, vol. 2, p. 589. According to Mr. Neison the number of members sick during each year at the soldiers' age is 220 per 1,000 in friendly societies. Contributions to Vital Statistics, p. 160.

NATURE OF DISEASES.

attacks of illness in the year instead of one. At Peshawur, during the same period, the admissions into hospital were 3,635 annually to 1,000 men, and in the hill stations of Kussowlie, Subathoo, and Dugshai, the admissions into hospital were at the rate of 1,783 per 1,000. The returns which Sir Alexander Tulloch gave in show that the attacks of sickness ranged from 988 to 3,225 per 1,000 men at different stations. 5563.

The attacks of sickness were sometimes slight; but in a large number of cases they were severe, painful, and fatal. Of the cases in the Bengal presidency before referred to, 75,535 were fevers, and 32,771 were diseases of the stomach, liver, and bowels, of which 2,517 were fatal. Add the 918 deaths by fevers, and the aggregate of 3,435 deaths leaves 1,021 referrible to other diseases.

Life-loss and Sickness in War.

LIFE-LOSS IN WAR.

The mortality of the army from disease in India has always hitherto been raised by war. This is evident upon inspection either of the mortality among the Company's troops, or the Queen's. The Company's European troops died at the rate of 85, 134, and 101 per 1,000 in 1803–4–5; the period of the Mahratta war.* In the wars of the Marquis of Hastings, the mortality of the troops rose to 90 and to 117 per 1,000; in six of the years 1813–21, the annual mortality exceeded 90 per 1,000. In the Burmese war of Lord Amherst, the mortality of the Europeans was at the rate of 113, 106, and 130, in the three years 1824–6. Since that the Company's forces have been healthier in war; in the Afghan and Sikh campaigns their mortality has not exceeded 70, 80, or 84 per 1,000. The whole army is rarely engaged; consequently the effects of a war are partial, and fall upon particular regiments. Thus in the year 1845 the mortality of the Queen's troops was at the rate of 199 per 1,000 in Bengal, but did not exceed 46 in Madras, and 71 in Bombay. The Queen's troops in 1840–8, out of a force varying from 8,000 to 12,000 in Bengal, lost numbers ranging from 781 to 2,213 annually; and the mortality frequently exceeded 10 per cent. It is impossible to read the losses of particular regiments in the war of the mutiny without being struck by the inextinguishable valour of the British soldier: but it was disease, and not the enemy that killed him. For out of 9,467 men dying among regiments in India prior to the mutiny, or sent out in 1857–8, only 586 were killed in action or died of wounds. All the evidence goes to show that the mortality in the wars of India is chiefly from the diseases before referred to; and that the diminution in the mortality of wars before the mutiny was due 5563.

* The troops had sometimes salt provisions and drank hard. Such passages as the following meet the eye in the Wellington Despatches:—"Urge the gentlemen there to send forward 3,000 or 4,000 gallons of arrack. * * * Salt provisions will also be much required, as the Bombay sheep contractor had failed entirely."—Camp at Poona, 15th May 1803, vol. v. p. 576.

LIFE-LOSS IN WAR.

to improvements in the sanitary arrangements. The battles in Sinde and the Punjab were as fiercely contested as any in which English troops have ever engaged native forces.

INEFFICIENCY IN THE ARMY OF INDIA FROM SICKNESS.

INEFFICIENCY FROM SICKNESS.

Of 1,000 of the East India Company's labourers in London, 16 were constantly sick, on an average at the ages 20–30; and in the friendly societies of England the amount of disability among artizans is nearly the same at the same ages. At the next decenniad the proportion of constantly sick becomes 17 or 20 in 1,000.* It was calculated by Mr. Annesley, the author of a standard work on the diseases of India, that 100 sick out of the same number was a normal state in India! This important element has not hitherto been sufficiently attended to in the army statistics; † and as we have not the new returns, recently introduced, it is impossible to show how much of the inefficiency is caused by each disease. Several diseases, such as rheumatism, ophthalmia, and syphilis, which are rarely fatal, cause a great deal of inefficiency, of which the admissions into hospital furnish a very inadequate measure. On the other hand some fatal diseases, such as cholera and consumption, produce very different amounts of sickness; for a fatal case of consumption lasts two years, of cholera two days.

The Table shows that, on an average in the stations of Bengal, 84 men in a battalion of 1,000 were constantly in hospital.‡ We have not illustrated this by a diagram, but it is easy to conceive the facts; 1,000 men are at a station; 84 of their number are sick in the hospital, where 69 die annually.

With this amount of sickness, an army of 70,000 British in India has, so to speak, a vast hospital of 5,880 beds constantly full of sick, and loses yearly by death 4,830 men, or nearly five regiments.

COST OF THE BRITISH SOLDIER IN INDIA.

COST OF THE SOLDIER.

The military expenses of India for the year 1856–7 amounted to 13,322,859*l.*, including the home charges for recruits, transports, and ineffectives. Deducting 166,386*l.* for the local civil corps, 13,156,473*l.* remain.§

The European officers and men in India in 1856 were 45,104, to which should be added, perhaps, 9,021, in depôts at home or

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* McCulloch's Statistics of British Empire, art. Vital Statistics, p. 582 and p. 587, and authorities there cited. See also Ratcliffe on Sickness of Members of Friendly Societies, 1862. The observations on the East India Company's labourers in London extended over the 10 years 1823–33.

† The new English system had not at that time been introduced in India.

‡ Average annual strength, 18,285; number constantly sick, 1,542·25; annual admissions into hospital, 36,814; annual discharges and deaths, 36,767; annual deaths, 1,040. Sanitary Statistics, p. 589, fol. ed. vol. I.

§ Parl. Pap. (32), 18th Feb. 1861.

Cost of the Soldier.

on their passage, making 54,125 in the pay of the Indian Government.*

The financial accounts do not enable us to determine directly the cost of the European force, as the expenditure is mixed up with that of the native army. But an approximate estimate can be framed. The native non-commissioned officers and men in the year were 235,221. The ratio of the cost of the Europeans to that of natives may be set down as 289 to 100, or nearly as 3 to 1.† Consequently the cost of 235,221 native soldiers is equivalent to the cost of 81,349 European soldiers. This number, added to the 54,125 Europeans, makes the cost of the Indian army equivalent to the cost of 135,474 Europeans. But the total military expenses, 13,156,473*l.*, divided by 135,474, gives 97*l.* per man as the annual cost of the European force; or, taking only the Europeans serving in India (45,104), the whole force is reduced to 126,453, and the cost per man is 104*l.*

For our present purpose it may be assumed that 100*l.* a year on an average is expended on the European soldier serving in India; this cost including the cost of arms, recruiting, and retired allowances for officers and men.

The finance accounts of the army are defective, and often delusive; but the various recent reports, and particularly the papers by Colonel Baker and Sir Alexander Tulloch, on the relative expense of the late Company's European Troops, throw much light on the subject, which has also been discussed with impartiality and judgment by Mr. Hammick. We have appended a Table, compiled from his, giving the chief results; for the sanitary state of the army is intimately linked with the finances of India, and influences them to a large extent.

Table 3 [p. 132 *post*].

The frequent errors in estimating the cost of troops in India arises from the omission of important items; indeed Colonel Baker omits, in his Table, staff charges in India, and the cost of camp equipage, ammunition, arms, stores, punkahs, bedding, hospital attendants, medicines, and transport in India, which raise the cost of a regiment 1,000 strong to 100,000*l.*

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* On Sept. 3, 1858, the total strength of the [European] cavalry and infantry regiments in India was 81,971; but only 50,979 were fit for duty, 6,616 being sick, 11,555 on passage out, and 12,821 in the depôts at home. To 57,595 in India, including the sick, 24,376 were away; to 100 present 42 were absent. Colonel Wood says nothing about the numbers "on passage home," but in pronouncing the number on passage out large, says, that "when a force is stationed at a distance from "home, there must always be a large number in transit *to and fro*." The number absent at this period was unusually great, and instead of adding 42, we have added 20 per cent. to the numbers serving in India. The legitimate purposes of the depôt are recruiting and training in order to maintain the efficiency of the regiments in India. (Appendix to Report of Commission on Organization of the Indian Army, p. 24.)

† In the Appendix to the Report on the Organization of the Indian Army (1859), p. 55, the cost (including rations, clothing, and other charges) of 1,067 non-commissioned officers and privates of an infantry regiment of Her Majesty's service is set down at 25,999 rupees 8 annas monthly; and the cost of 1,140 non-commissioned officers and men, including 1,000 sepoys, of a native regiment at 9,606 rupees 14 annas monthly; the cost of the European is to that of the native soldier as 2·8915 to 1. The other charges not here brought into account are assumed to be in the same ratio.

Cost of the Soldier.

The annual pay of infantry non-commissioned officers and privates is at the rate of 60*l.* 13*s.* 11*d.*, or nearly 61*l.* per man (including clothing, victuals, barracks, and allowances); the cost of transport by sea, including officers, 7*l.* 1*s.* 5*d.*; of levy money, recruiting, and depôts, 4*l.* 14*s.* 4*d.*; and of pensions, 9*l.* 3*s.* 2*d.*, or in the aggregate, with the pay of officers, 81*l.* 12*s.* 8*d.*, which is raised to about 100*l.* by other expenses.

It will be observed that the charge for barracks and buildings is 13*l.* 3*s.* per man, so that the accommodation of ten men costs 131*l.* a year! This is a high rent; yet Colonel Baker says he had in his late office of Secretary to the Government of India peculiar opportunities of knowing the cost of permanent barracks for European regiments on the enlarged scale lately introduced, and is satisfied that the annual amount will not be less than 15,000*l.* a regiment.* Sir Alexander Tulloch quotes a return, on the other hand, to show that the building of a barrack for a whole regiment 10 or 20 years ago cost only 22,213*l.*, which implies, he says, an annual expenditure of 2,200*l.* a year.

The value of a man who, with all his arms, costs the country 100*l.* a year, reckoned at only a few years' purchase, is considerable, and either the loss of his life, of his health, or of his efficiency, is not to be lightly regarded, especially as it occurs most frequently and inopportunely in the field, when his services are required.

Pecuniary Cost of Sickness in the Indian Army.

Cost of Sickness.

It may be assumed, as the sick soldier is a serious encumbrance in warfare, that the 5,880 sick cost the country as much as 5,880 effectives; if there were no sick the army might be reduced to that extent. And as it has been shown that the army expenditure is equivalent to 100*l.* per man, the cost of the sick at these rates is 588,000*l.* annually. Deduct 200,000*l.* for sickness, assumed to be inevitable, and 388,000*l.* remain.

Mortality among Officers of the Indian Army, the Civil Servants, Retired Officers, and Pensioners.

Mortality among Officers, &c.

The Royal army, out of 9,192 officers in the year 1860, lost all over the world 244 by death; and the mortality was at the rate of 27 in 1,000. The mortality of the 3,965 officers of the Royal army serving abroad was 30 in 1,000 during the four years 1857–60, including the period of the Indian mutiny. In 1861 the mortality of officers was 16 in 1,000.

We have no recent returns of the mortality of officers serving in India, but there is no reason to believe that the rate varied much before the mutiny; and there is ample data for the essential purposes of this inquiry.

The 20th volume of the Asiatic Researches contains the results of an inquiry respecting the law of mortality for British India.

* Appendix to Report of Commission on Organization of Indian Army, pp. 49, 50.

Mortality among Officers, &c.

The facts, procured by the Government, were arranged by the late Col. Henderson with clearness, and they may be used with confidence.

The East India Company had on an average, during the 20 years 1814–33, serving in India 4,219 military officers,* among whom 3,194 deaths occurred; consequently the annual mortality was at the rate of 38 in 1,000. Several of these officers were in civil employ, and some were on leave of absence; but they were all exposed to the Indian influences. This was not the case with the 1,079 officers of the Royal army, a considerable number of whom were apparently at the depôts in England; so the deaths were 742, and the annual mortality was at the rate of 34 in 1,000. The annual loss of the 5,298 officers of both armies was 197. Now of men of their ages in England about 53 die annually; consequently 144 officers died every year in India in excess of the natural deaths. In the 20 years the deaths at the English rate would have amounted to 1,060; and as 3,936 officers died, the excess by violent and unnatural causes was 2,876. Of this number 122 were killed in the field or died of wounds; consequently, while the danger to which they were exposed on the field of battle was fatal to 122 officers, the dangers from disease were fatal to more than 20 times that number!

The diseases were undoubtedly of the same character, and were, in fact, the same as those which kill the soldier. And the number of sick officers probably bears the same proportion to the deaths as has been found to exist in the returns of non-commissioned officers and privates. So the number of sick officers in India and on leave of absence from ill health is considerable, but it is not returned; and, if it were, the loss from the inefficiency induced by disease would be only imperfectly represented by the numbers on the sick list and absent from the field,

The value of the lives of officers, and the irreparable consequences of their loss to their families, pointed out at an early period the necessity of extraordinary measures for the promotion of life insurance, and led to the establishment of the various funds under Government encouragement.

One of the disadvantages to the officer arising from the insalubrity of India is shown by the high premium which he has to pay for the insurance of his life. Thus, at the age of 30, the annual premium of the insurance office on a life in England is 2*l.* 4*s.* 10*d.*; on an officer's life in India it is 4*l.* to insure 100*l.*

The soldier's life is still more precarious, and, allowing 10 per cent. for expenses, by his life table he would have to pay 5*l.* 15*s.* 3*d.* to insure the same sum at death. To the same extent as the shortening of life increases the risk of insurance it diminishes the accumulation of capital.

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* Each officer, after 10 years' service, was entitled to absence from India for three years, and to further absence in case of sickness after or before that term. After 25 years' service, 22 in India, officers were entitled to retire on the full pay of their rank.

MORTALITY AMONG OFFICERS, &c.

It will be observed that while during a long series of years the mortality of the soldier in India was at the rate of 69,* the mortality of the officer during 20 years was at the rate of 38 in 1,000. And it appears to be a fair deduction from this comparison, that the 31 annual deaths in excess of 38 are due to other causes than the climate of India; to which officers as well as men are everywhere exposed. We may proceed a step further in this direction; for the civil servants living in the unhealthy and healthy districts alike died at the rate of 20 in 1,000.†

The mortality of the Bengal military officers of the Company was at the rate of 31, Bombay 39, and Madras 45, in 1,000. Of the officers of the Royal army in India, the mortality was 34 in Bengal, 33 in Bombay, and 36 in Madras.‡

The local disadvantages of Bengal were in those days in some way compensated; and the returns of the military funds of the several presidencies confirm this result.

In order to determine accurately the mortality of officers, it is necessary to take their ages into account, as their mortality varies with age in India as in England; thus it will be seen that the mortality is greater in the higher ranks of officers than in the subalterns.

The mortality of officers of all ranks, deduced from the most authentic materials, is given below:—

Facts supplied by.	Years.	Annual Deaths per 1,000				
	Age -	20	25	30	35	40
Col. Henderson, (India) - -	1814–1833	29	33	35	39	40
Mr. G. Davies, (India) - -	1760–1839	27	28	31	33	37
Mr. Neison, (India) - -	1800–1847	24	25	28	29	30
Do.	1840–1847	25	32	34	31	36
Mr. S. Brown, Madras Military Fund.	1808–1857	33	32	30	27	30
Men in all England - - - - -		9	10	11	12	14
Men in healthy districts of England - -		7	8	8	9	10

The Table may be read thus: the mortality at the age 20 and under 25 was at the rate of 29 in 1,000 Indian officers, according

* During the 20 years 1814–33, for which the mortality of officers was 38, the mortality of the non-commissioned officers and men was 83 in 1,000. By taking the general rate 69, the case is understated.

† "In the civil service the per-centage of mortality for the last 40 *years* has been somewhat under 2 per cent. for the first 20 years of residence in India, a result far more favourable than that of the other services."—[Colonel Henderson, Asiatic Researches, vol. xx., p. 199.]

‡ Asiatic Researches, vol. xx., pp. 201–3.

MORTALITY AMONG OFFICERS, &c.

to the return of 1814–33;* at the age of 40 and under 45 it was 40 in 1,000. The mortality varies in different times and places as its causes vary.

The rate of mortality in the whole of the civil service of Bengal was, according to the returns of Mr. H. T. Prinsep, at the rate of 21·0 at the age 20–25; 20·1 at the age 25–35; 28·7 at the age 35–45; and 41·1 at the age 45–55.† In the Bombay civil service the mortality ranged from 24 to 26 under the age of 50.‡ The experience of the Madras civil fund from 1760 to 1853 exhibits a still more favourable result. The mortality ranged at the ages of 20 to 45, from 14 to 18 in 1,000; and at these ages the authenticity of the Table is unshaken by criticism.§

Table 16 [p. 143 *post*].

To illustrate the extent to which the insalubrity of India affected civilians, officers, and soldiers in India, we take four armies, each consisting of 33,615 young men of the age of 19. The first army remaining in England experiences the ordinary rate of mortality, and loses 254 in the first year, 276 in the second, 281 in the third, and so on; it is reduced to 30,453 men of the age of 30 in 11 years. The second army loses also 254 men in the first year; and it then lands in India, where it loses 353, 412, 452 men, as it suffers from the diseases and dies at the rate of Madras civilians: it is reduced to 28,916 men in 11 years. The third army out of the same strength loses 254 in the first year, or at the age 19–20; it then lands in India, and experiences the same rates of mortality as the military officers, and loses 865, 840, 819, and so on in successive years until it is reduced to 24,610 in 11 years. The fourth army loses 254 in the first year; it then lands in India, and suffering from the diseases of the Company's soldiers, it loses 2,052 in the first year of its residence in India, 1,811 in the second, and so it is rapidly reduced by death to 19,617 in 11 years.

Table 14 [p. 141 *post*].

If there is much to shock the mind in these contrasts, they do not lack elements of consolation, for the unnatural death of the English soldier is apparently not the inevitable result of the climate of India; to which officers and civilians are also exposed.

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* See the annexed Tables 17, 18, 19 [pp. 146–7 *post*]. For other returns, see the Report of Messrs. Finlaison and Lewis on Bengal Military Fund, as well as Mr. Neison's Reply.

† Asiatic Researches, vol. xx., p. 230.

‡ See Report of Griffith Davies on Bombay Civil Fund, dated 20th February 1836. In the reports upon the Indian Fund (p. 375) the probability of dying is incorrectly called the "*rate of mortality*," so as to mislead the unwary reader. Thus, if on an average out of 100 men living at the beginning of a year there are ten deaths in the year following, the probability of dying is expressed by the fraction $\frac{10}{100}$, which is incorrectly called in the reports "the rate of mortality;" but the rate of mortality is $\frac{10}{95}$, for the numbers living at the end of the year are 90, and the years of life are 90 + 10 half years, which it may be assumed are lived by the 10 who died in the course of the year. For the general formula for passing from the probabilities of dying to the corresponding ratio of mortality, see Table 12 [p. 138 *post*].

§ See Mr. Neison's Report on the Madras Civil Fund, dated 20th July 1855. The expectation of life is not higher by this Table at the age of 55 than it is by the Table for healthy English districts; but the discrepancy of its results with Mr. Neison's earlier table is by no means fatal to its authority.

MORTALITY AMONG OFFICERS, &c.

But, while the soldiers live together in common bedrooms in barracks, the officers generally reside in separate bungalows, where they have the due arrangements for cleanliness; their food and drink are of superior quality; their contact with the sick in hospitals is limited to periodical inspections; when ill themselves they have the advantage of separate apartments, and obtain leave to resort to healthy places. The military and civil servants of the Company were entitled, after 10 years' residence in India, to three years' leave of absence with gratuitous pay; and this period, by illness and medical certificates, could be extended to five years, which counted as a part of the 25 years entitling them to retire on the full pay of their respective ranks. In the hope of attaining higher rank or higher pensions, or for other reasons, the period of service in India was often extended.

The married officers are healthier than the unmarried. The civil servants are distributed all over India, and are necessarily exposed not only to heat, but to the influence of malaria, and occasionally to casualties from bad water; but their dwellings are, it is believed, better placed than the bungalows and barracks of the army; they also enjoy the comforts of homes, are married, and are exposed to none of the accidents of warfare in the field. They are occupied, and their minds are often actively engaged in the discharge of their duties. They are not driven to drink or debauchery by *ennui*.

The civil servant and the military officer at the close of their career habitually return to England, where they encounter the cold vicissitudes of a climate in which they were born, but to which they have long been unaccustomed. The "old Indians" are divided into two classes. The veterans who, like Hastings and the Wellesleys, bring home their native vigour, tempered in the Indian fire; and those who are either shattered by fevers, dysentery, liver diseases, and apoplexies, or are actually suffering from their sequels. Sir Ranald Martin has described their condition, and has shown how it can be ameliorated.*

The returned officers experience a higher rate of mortality at all ages under 65 than the people of England; but their mortality is lower at all ages than the mortality of officers remaining in the military service. Looking at some of the results it is questionable, however, whether veterans would not enjoy better health in retirement in the healthiest parts of India than they enjoy in England.

See Table 16 [p. 143 *post*].

The pensioners in England who have served in the East and West Indies die much more rapidly than officers; but this is probably due to the circumstances in which they are placed. And it is not an easy matter to throw off at home the habits of dram drinking which they have been taught in the tropics.

The retired civilians probably enjoy the same advantages over the military in England as they enjoy in India; for many of their eminent members, after having served for a certain time in India,

* Diseases of Tropical Climates, by Sir Ranald Martin.

Mortality among Officers, &c.

attain advanced ages. Only one governor-general (Cornwallis) died at his post in India during 90 years; and although the careers of the last two terminated prematurely, the 14 eminent men who have held that high office since 1772, for periods varying from one to ten years,—or six years on an average,—filled their expected number of years by the English life table.

In a previous section it was shown that the mortality of the British troops had been at the rate of 69 in 1,000 for a long series of years; but at stations in every variety of the climate of India the mortality has not exceeded 20 or 30 in 1,000; the excess of deaths over 10, being due to a few diseases, are referrible to local causes, which were at one time equally fatal in their operation in England. In the present section the facts lead to similar results.

1. The mortality of the officers who were stationed with the British and native troops (regular and irregular) all over India was excessive, and involved great losses of life and property; but it was less by 31 in 1,000 than the mortality of the soldiers. It follows that the lives of nearly half the soldiers, in less unfavourable conditions, might for the future be saved.

2. The civil servants at the soldier's age did not die at a rate higher than 20 in 1,000; and as they are distributed all over the country, it follows that the climate of India is not necessarily fatal to any higher proportion. The excess is due to other causes.

3. The diseases of the India civil servants, from which they have a comparative immunity in England, are known to be the same as are fatal to the soldier.

Mortality among Native Troops and Native Population.

Mortality of Natives.

The Asiatic soldiers of the Company are called native troops in the returns, while the British are called Europeans. These are merely local designations, and, as such, the former term must be understood to mean that the troops are natives of India, but not always natives of the provinces in which they are stationed.* The natives of the upper provinces serve in Bengal Proper, which Colonel Henderson said is "so injurious to this class of *natives* "that, although only one-fourth of the troops are stationed in "Bengal, the deaths of that fourth are more than a moiety of the "whole mortality reported."†

The secretary of the Bengal medical board returns the mortality of the native corps at the several stations of the army where European troops are cantoned as 7·6, or less than 8 in 1,000;‡ but the rate was as high as 27·6 at the presidency station, 18·0 at Barrackpore, and 15·0 at Dum-Dum. At many stations the mortality of the sepoys was as low as 4 in 1,000; but, in addition, "many unrecorded deaths occurred at their own homes, where "bad cases were allowed to proceed on medical certificate."

* Assistant Surgeon E. Balfour, Jour. Stat. Soc., vol. viii., p. 199.
† Asiatic Researches, vol. xx., p. 192.
‡ Asiatic Researches, vol. xx., pp. 193, 209-10.

MORTALITY OF NATIVES.

The more recent returns have been drawn up from other sources; and a paper by Colonel Sykes gives the mortality of the native troops from the military returns in an authentic form for the 20 years 1825–44.*

The mortality of the native troops of the three presidencies was at the rate of 18 in 1,000. At the same time 19 in 1,000 were invalided. The ages of the men range from 18 to 45; and their ascertained mortality is therefore about 8 in 1,000 higher than the mortality of England. It was 36 in 1,000 less than Colonel Sykes makes the mortality of the European troops (54) for the same years, when the Europeans also lost 29 in 1,000 by invaliding.

The ascertained mortality of the native troops was, in Bombay, 13; Bengal, 18; and Madras, 21 in 1,000; the invaliding having, however, been in very different proportions in the three presidencies, namely 33 in Bombay, 15 in Bengal, and 20 in Madras. Invaliding is, unfortunately, a very vague term in the language of the army, for as it includes a variable proportion of the men annually discharged, the results are to be used with caution; and it is certain that many of the invalids carry away fatal diseases, so that the mortality of the native army was, probably, not less than 20 in 1,000. Of the mortality, the proportion by cholera was 2·8 in Bombay, 2·2 in Bengal, 5·8 in Madras.

Inspector-General Macpherson, of the Madras presidency, gives a return, from which it appears that the mortality of the native troops was at the rate of 18 in 1,000 during the 16 years from 1842 to 1858; and as 6 in the 1,000 were deaths from cholera, the mortality, if that disease could be extinguished, would be 12 in 1,000. The invaliding is not given. The mortality of the native troops, according to Inspector-General Pearse, during the 10 years (1847–57) was at the rate per 1,000 of 7 at Jaulnah, where the European mortality was 10; 8 at Bellary; 8 at Cannanore; 9 at Secunderabad; 10 at Bangalore; 11 at Madras; 16 at Trichinopoly; 17 at Singapore; 23 at Moulmein in the Pegu division; 29 at Labuan. In Sinde the Bombay native army died at the rate of 43 in 1,000 during the years 1842–4.† The mortality of the "native [Indian] troops" in the last China expedition was, in 1860, at the rate of 32 in 1,000; when the mortality of Europeans was 48, or, including invalids who died on the way home, 54. Applying a similar correction to the Indians, their mortality per 1,000 must have been about 36 in 1860, and 60 in the previous year, chiefly from the zymotic diseases.‡

The Bombay army consisted before the mutiny of Hindoos to a large extent (75 per cent. of their number); and in Bengal the proportion in the infantry was higher (83 per cent.); while in Madras the proportion was lower (60 per cent.) In Bengal,

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* Journal of Stat. Soc., vol. x., pp. 100–31.
† Journal Stat. Soc., vol. x., p. 104.
‡ Army Medical Report, 1860, pp. 101–11.

too, the Hindoos were principally Brahmins and Rajpoots, while in Madras the lower castes predominated.* Mortality of Natives. 5780.

The native troops are for the most part married; their pay exceeds the earnings of the rest of the population; and, except in Bengal, the wives live with their husbands in small huts, which are made with skill and little labour, of the bamboo and matting. The Brahmin of Bengal leaves his wife at home, but visits her hut periodically on furlough. A hut, Dr. Wallich supposes, does not cost above two rupees, and lasts for a few years. The men have their bedsteads outside, except in the rains, and generally sleep outside. The Hindostanee sepoy does not taste meat, fish, or spirits, but lives almost exclusively upon unleavened cakes of wheat flour, daily baked upon an iron dish, and washed down with water.† Mahomedans and low-caste Hindoos, such as the Mahrattas, who are Sudras, consume animal food, ardent spirits, ganja (hemp water), and opium. A return from Madras for 1848 shows that in that year the mortality of the Hindoos was at the rate of 12, when the mortality of the Mahomedans was 10, in 1,000.

The attacks of sickness among the Indians were at the rate of 667 in 1,000 during the same period of 20 years; when the Europeans sent more than twice that proportion (1,590) to hospital.‡

The numbers admitted into hospital give an imperfect idea of the sick-time from each cause; but the excess of mortality among the native troops is chiefly due to cholera, dysentery, and fevers,—the same diseases that are fatal to Europeans; and the disparity in the deaths by these diseases is not considerable. Thus, in the Madras presidency, when the mortality of the Europeans was 48·6, and of the native troops 16·1 per 1,000 from all causes, the mortality of the two classes from cholera was at the rates of 7·6 and 4·0, of fevers 5·6 and 3·5.§ Far different were the mortalities from the other diseases; thus, among the two classes the mortality per 1,000 was 15·0 and 1·0 by dysentery, 5·6 and 0·1 by liver diseases, 1·7 and 0·2 by apoplexy, inflamed brain, and insanity. Three diseases, exceedingly prevalent, serve to show that the attacks of sickness also differ in the Europeans and natives; thus, taking 1,000 men of each class, and under the rheumatism of the army 102 cases of Europeans are recorded, 53 of natives: by ulcers and abscesses 74 Europeans, 42 natives suffered. But the Europeans sent cases of syphilis to hospital at the rate of 192, the natives at the rate of 23 in 1,000.‖

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* Journal Stat. Soc., vol. x.

† Colonel Sykes' Stat. Jour., vol. x., p. 124. Other cereals are also used, as well as wheat.

‡ The old medical returns overstate the attacks of sickness, or the numbers "treated," by erroneously adding the remaining at the beginning of each year to the new cases admitted during the year. The numbers treated are approximately represented by the mean of the cases admitted and discharged in the year.

§ Years 1827–38. Paper by a Committee of the Statistical Society on data furnished by Mr. Annesley, the President of the Madras Medical Board.—Journal Statistical Society, vol. iii., p. 127.

‖ See also Jour. Stat. Soc., vol. xiv., p. 129, where the same disparities are shown for the years 1842-6.

MORTALITY OF NATIVES.

Table Nos. 7 and 8, p. 583. fol. ed.

In Bengal and the North-western provinces (1852–3) the admissions of native troops into hospital were at the rates of 1,181 per 1,000 of the strength, including 678 cases of fevers, 127 of dysentery, diarrhœa, and cholera, and 28 of syphilis. The mean number of natives sick in 1,000 at the beginning and end of the year was 30, 9 by fever, 3 by bowel diseases, 3 by rheumatism, 2 by syphilis, 6 by abscess and ulcer, 2 by wounds and injuries.

The English troops of the Madras army in 1842–6 sent 189 cases per 1,000 annually to hospital for syphilis, while the native troops sent 31. Colonel Sykes says "*only* 31," and adds, "as "might be expected from the majority of the men having their "families with them."

Further instances will be found in innumerable returns, which it is unnecessary to discuss, as it is evident that the mortality of the native Indian troops does not exceed 20 in 1,000, and that in many healthy stations it does not exceed 10 in 1,000. The excess over 10 is not inevitable, for it is referrible, as we shall afterwards show, to malaria, bad water, and bad sanitary arrangements. The army is besides always surrounded in India by a multitude of followers, among whom cholera and other epidemics often break out and infect the troops. The sepoy's pay does not exceed a third of the pay of the Englishman, but he has an instinctive horror of barracks, and retires from duty to the lines, where he finds his hut, into which not even the doctor dares to penetrate. The sepoy there is free; his hut is his home. There he enjoys quiet; he has often the society of his wife and children. The sepoy, in a hut which costs two, or, it may be, four rupees, appears to live three times as securely as the English soldier in barracks, which cost 131 rupees per man annually.

The census and the registration of deaths have never been carried out effectively, so as to enable us to determine the mortality of the native population with certainty, even in the cities, except perhaps for Calcutta. Dr. Strong has shown that among the natives of all ages, the mortality was at the rate of 51 in 1,000; the Hindoos dying at the rate of 57, the Mussulmans at the rate of 35 in 1,000.* The mortality fluctuated in 11 years from 37 to 81; and winter, as in England, was the unhealthiest season. The mortality of the suburbs is unknown.

The mortality in Delhi, containing 119,860 inhabitants, was at the rate of 36 in 1,000 in 1833; and the mortality of males differed little from that of females. The palace of 20,000 people is not included. It is, as might be inferred from its situation, less unhealthy than Calcutta.†

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* Stat. Journal, vol. viii., pp. 50 and 52. The population of Calcutta city in 1837 was 229,705, while the suburbs held 217,193. The city contained 144,893 males, 84,812 females, in this, as in some other respects, resembling St. Petersburg. See also a Paper by Mr. Bedford, the civil assistant surgeon, on the Vital Statistics of Chittagong (Jour. Stat. Soc., vol. xv., p. 129), in which he estimates the mortality of that town at 27 in 1,000. See also Sir Ranald Martin's valuable Report on Calcutta.

† Asiatic Researches, vol. xx., p. 191.

Mortality of Natives.

The mortality of Indian cities is not higher apparently than that of the European cities in the same unhealthy conditions.

The native troops, it will be seen, experience a rate of mortality nearly the same as that of the civil servants, living also in homes, but born in England; and they suffer from nearly the same fatal diseases. But the sepoy's superiority in health over the English soldier has often hitherto been explained on the hypothesis that his organization is especially adapted to the climate in which he was created! But it is found that the sepoy suffers when he leaves his home, whether quartered in Bombay or in Southern China; and when taken from his hut he is shut up in Indian prisons, in his own climate he dies at greatly increased rapidity, —84 in 1,000 in Lower Bengal during 10 years—and of some of the same fatal diseases as destroy the English soldier in Indian barracks.*

The famine fevers, which are periodically fatal in India, as they were formerly in England, can be mitigated by improvements in the systems of culture, storage, and intercommunication. The Asiatic cholera, which sprang into epidemic life in India, may, like the Pahli plague,† be arrested at its source.

Fevers, rheumatisms, diarrhœas, choleras, dysenteries, scabies, herpes, lepra, and ulcers, which now abound, and afflict so heavily the natives of India, may be diminished. But the task is undoubtedly difficult. It depends largely on the general improvement of the people. Their superstitions stop the progress of vaccination;‡ the women derive little benefit from medical advice, as they are seldom willing to see the surgeons of the dispensaries, and the sanitary condition of their towns is utterly neglected.

Java, under the tropics, is increasing rapidly in population, and in certain districts the mortality of the natives does not exceed 17 in 1,000. There appears to be no reason why India should not make equally rapid progress in population and salubrity under English rule.§

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* "Last year, I am afraid," said Dr. Mouat, "the mortality has averaged 12 per cent." [120 in 1,000] "upon the average number who were in custody in Bengal."—Evidence, Qu. 5792. See Dr. Mouat's able Report on Indian Prisons, Stat. Journal, vol. xxv., pp. 175–218.

† The fever called Pahli plague is of a malarious, remittent type, becoming in its progress of the continued character, and manifestly infectious under the favourable conditions of privation, filth, crowding, and defective ventilation. The term plague was applied to this fever from the circumstance that it became typhous in its course, and that glandular swellings arose, as in true plague, in the groins, axillæ, and neck. It has been known in India from 1815 to 1820, in Kattywar, Cutch, and parts of Guzerat. In 1836 the same form of fever prevailed at Pahli in Marwar, whence the designation latterly given to it in India.

‡ 23 in 100 deaths are by small-pox among the Hindoos of Calcutta. Jour. Stat. Soc., vol. viii., p. 54.

§ The population of Java was 6,368,090 in 1824, and 9,542,045 in 1845. In a population of 40,688 in 188 villages, Mr. Crawford ascertained that the marriages were 514; the births, 1,691; and the deaths, 696. Stat. Journal, vol. xii., pp. 61, 69.

Mortality among European Population: Officers' Wives and Children; Eurasians.

Mortality of European Population.

The English population in India, according to the returns of the several Governments, amounted to 125,945;* consisting of an army 84,083 strong, its wives and children, and people in civil life, including the civilians in the public service. Allowing for any defects in the returns, it is evident that, exclusive of the army, the population would not fill one English county town; and including the army, it would be less than the population of the London parish of Marylebone.

Table 29 [p. 154 *post*].

Of the Royal army, the proportions married, it will be seen, vary at each age; 93 per cent. of all ages were unmarried men; of the Europeans of the late Company's regiments, 70 per cent. were unmarried; of the civil population, of the age of 20 and upwards, 50 per cent. were unmarried,—a large proportion as compared with the unmarried population of England.

A higher proportion of the officers than of the men in the Royal army is married.

The rate of mortality among the married soldiers and the unmarried has never been ascertained in either service; but Mr. Griffith Davies ascertained that the married officers in the Bengal Military Fund died at the rate of 27 in 1,000 annually, the unmarried at the rate of 38 in 1,000. The subject requires further investigation. This excess of 11 deaths annually is the more remarkable as the unmarried officers are younger than the married. The married ensigns died at the rate of 16, the unmarried at the rate of 36 in 1,000 annually.† Here the life without a home in India is triply fatal.

The women and girls enumerated as "British-born subjects in India" amounted to 19,306, of whom 9,773 were 20 years of age and upwards, including 7,570 wives, 1,146 widows, and 1,001 unmarried women. 786 wives under the age of 20 make the number of wives of English origin, under the age of 45, to be 7,626, scattered all over British India.

The wives of several Indian officers, if invalids, go to England; but the numbers in India in the early periods is so great that the mortality of the wives of officers of the Indian army may be taken to represent the mortality of English women in India. At the ages from 20 to 40 the mortality of wives and of widows in the Madras Military Fund does not, according to Mr. Samuel Brown, exceed 14 in 1,000. They are exposed to many of the same unsanitary influences as the soldier and the officer. The mortality is not higher than it was in London during the last century. All the deaths over 10 in this class, as in the others which have been

* The European officers and men of the army in India were 84,083, the civilians were 22,556, and the women were 19,306, at the census of 1861. The Registrar-General of England has kindly supplied us with the results of the last census, which was made at his instance in 1861. We are indebted to Major Graham and his department for much valuable aid in other respects.

† Journal of Stat. Soc., vol. viii., p. 54.

Mortality of European Population.

investigated, are by the diseases not only of India, but of all unhealthy places. They may be reduced by energy and action, as they are increased by inaction.

Young children are generally easily affected by the climate, and it is found that the mortality of English children in India is lower than the general mortality of children at home. It is higher than the rate of mortality which the children of the same classes experience in the healthiest districts; but it is lower than the rate of mortality which the children of England generally experience. As age advances, large numbers of the children are sent home at great expense; and in Lower Bengal it is well known that if they remain they become feeble, and suffer from impaired health.

The wife and children of the non-commissioned officer and soldier do not fare so well, as the provision for their accommodation is inadequate. The women are exposed to great hardship; they die at the rate of 35 per 1,000, including women of English birth and Eurasians.* In the lower orphan school of Calcutta the mortality was double or treble the English rates;† but more favourable results are obtained at the Lawrence military asylum in the hills.

At the census 11,636 women above the age of 15, of English origin, including 8,356 wives, were enumerated, and 98,888 men. Hence a certain number of soldiers marry Indian wives. The sons and daughters of the two races, known as Eurasians, or East Indians, or half-castes, amount to considerable numbers. They exceeded the English in the city of Calcutta at the census of 1837; for while the English amounted to 3,138, the Eurasians were 4,746,‡ or including those in the suburbs, 5,981. Mr. Tait and others have investigated the mortality from imperfect data; and we see no reason to justify the inference that the mixed race of Anglo-Indians is an exception to the rule, that the mortality of all the races in India bears a constant proportion to the variable sanitary conditions in which they live.

Having given an account of the mortality and diseases to which British troops in India have been exposed, we next proceed to state briefly a few facts regarding the mortality at the more important stations.

Stations in the Deccan and Southern India.

Stations in Southern India.

The station of Trichinopoly is within the tropics,§ in southern India, and is reckoned one of the hottest to which troops are exposed. The mean temperature of the latitude is 82°, according to Mr. Glaisher. The temperature of night is high, and of the day still higher in the shade; the sun being even in winter nearly vertical at midday. The mortality was at the rate per 1,000 of

* Moore, Health in the Tropics, p. 55.

† See Tables in Sir Ranald Martin's work on Tropical Climates, from a paper by Mr. H. Prinsep.

‡ Jour. Stat. Soc., vol. viii., p. 50.

§ Lat. N. 10° 50′.

STATIONS IN SOUTHERN INDIA.

Table 120, p. 751, fol. ed.

44 for 19 years, of 31 for 11 years, and of 20 for the four last years (1850–3), for which we have returns. The strength of the 84th Regiment, stationed there, was 1,001; the mean number constantly sick was 62; and the annual admissions into hospital 1,533.

Upon turning to the diseases it will be noticed that 4,593 of the 6,202 admissions into hospital are from zymotic diseases, so that 1,148 are admitted annually from these affections, and 402 from all other causes. 41 of the 81 deaths were from zymotic maladies; six from common fever in the army sense, 24 from diarrhœa, dysentery, and cholera. Moreover 53 cases of *vermes* occurred.

Deduct the deaths from zymotic diseases, and the annual mortality of Trichinopoly is reduced to 10 in 1,000. Among the other deaths, eight are returned as apoplexy, and seven as hepatitis.

We now cross over the Ghauts and descend to Cannanore, low on the Malabar coast, where the rainfall is 140 inches, and the temperature is still tropical. The mortality of a mean force of 903 in the 10 years 1847–56, was at the rate of 21 in 1,000; or, deducting the deaths from zymotic disease, 11 in 1,000. Of 192 deaths in 10 years, 53 were by dysentery and 25 by hepatitis.

Ascending the Cauvery from Trichinopoly into the Mysorean territory, instead of going on to Seringapatam, which has been abandoned on account of its unwholesomeness,* we turn northwards to Bangalore, far from the coast, and about 3,000 feet above the sea. The mortality of the 1,342 men at this station during the 10 years of the return was at the rate of 20 per 1,000 annually; and it was less in the last five years. The cavalry, strength 644, died at the rate of 17, the infantry at the rate of 24, per 1,000. Upon inspection it will be seen that cholera and dysentery and hepatitis were the chief fatal diseases, and if we exclude the zymotics, the mortality of the station from other diseases, including hepatitis, is less than 11 per 1,000.

Large numbers of European pensioners have resorted to Bangalore since the removal of the restrictions prohibiting permanent residence. They live on plots of ground in clean, comfortable cottages, and were enrolled during the mutiny. If they had grants of land for gardens they might supply the troops with vegetables. The veterans, numbering with their families more than 1,100, have the prospect of enjoying, with good sanitary arrangements, as long a life in India as their companions who return to England.

Northwards, at Belgaum, lying east of the Ghauts, 986 men were stationed; the mortality was for six years at the rate of 19

* The Duke of Wellington was not misled by this presumed unwholesomeness. His own regiment was uncommonly unhealthy there, but he writes :—"I apprehend, however, that Seringapatam is not really more unwholesome than Bangalore." "I apprehend that a great part of the sickness at Seringapatam is to be attributed to the nature of the buildings which the officers and the troops have occupied," &c.—Despatches, vol. i., pp. 352, 353.

Stations in Southern India.

deaths in 1,000 living, of which 11 were by zymotic diseases, chiefly dysentery. Belgaum was formerly part of the collectorate of Dharwar, where the culture of the New Orleans cotton has been successfully inaugurated; and it is probable that the mortality of Englishmen will, when the causes of dysentery are removed, be as low as in Europe. The mortality at this station was formerly at the rate of 28, and even 41, in 1,000.

The 10th Hussars and the 14th Dragoons were stationed at Kirkee, above Bombay, in the 10 years 1847–56, and their mortality was at the rate of 19 in 1,000, or, exclusive of zymotic diseases, cholera, dysentery, and fever, 7 in 1,000. The mortality from all causes subsequently to 1855 ranged from 6 to 15 in 1,000 at Kirkee.

At Poona, of which the town, filled by 80,000 inhabitants, is 3½ miles from Kirkee, the mean mortality was at the annual rate of 26 deaths per 1,000 living in 10 years, but of this number 16 were by zymotic disease: fever, dysentery, and cholera prevailed in the first five years, when the mortality was at the rate of 34 in 1,000. During the last five years the mortality at the station among 1,127 men was at the rate of 16 in 1,000, including a certain number of deaths from dysentery, cholera, and hepatitis. During the years 1857–60 the mortality was at the rate of 11, 6, and 34 annually, cholera having been epidemic in the latter year.

Abstract of stational reports.

Across the Nerbudda by the way of Baroda to the desert, we find Deesa, which is on the river Bunnass, but is visited by the breath of the burning desert, so that though out of the tropics, its temperature is extreme. The mortality of 893 men was at the rate of 26 in 1,000 during 10 years, or 12 exclusive of the zymotic diseases. The excess on the mortality over 10 is chiefly referrible to cholera, dysentery, remittent fever, and hepatitis. By the decrease chiefly of those diseases, the mortality from all causes in the last five years of the 10 was reduced to 20 in 1,000.

Stations in the Vicinity of large Cities.

Stations near Cities.

India differs from the colonies in one essential particular; it is peopled by the inhabitants of villages, towns, and large cities, as well as by families engaged in agriculture. As we shall afterwards show, the cities are still undrained, the earth is saturated with organic matter, the water is contaminated, and other sanitary defects abound. In these cities, zymotic diseases are aggravated, and assume the same destructive forms as they did in London before it was drained, and was supplied with water free from enteric impurities.

Extract from Registrar-General's tables, [p. 144 *post.*]

The health of the English army is indissolubly associated with the health of the population of the country which it occupies; hence it will be found that the mortality of the troops is above 20 in 1,000 at all the stations of the great Indian cities. The numerous camp followers always connect the cantonments with the city, and they exist in a community of suffering, as well as of advantage.

Stations near Cities.

Hyderabad, the capital of the Nizam's dominions, is on high land near the centre of the Deccan; it is surrounded by fine sites; but the barrack for the European regiments is in an unhealthy locality at Secunderabad. A regiment, of which the mean strength was 753, died at the rate of 64 in 1,000 annually:* in one year a third of the force was killed; and the deaths in the 30 years (1804–33), chiefly by dysentery, were about 1,435. The barracks were emptied twice by deaths in 30 years; and the graveyard close above the barracks was filled; for a crowded barrack crowds the churchyard. New barracks were erected on the same site, and the mortality declining, still remained as high as 37 in 1,000 during the years 1837–58. In the last year of the period, 104 of the First 2381–2. Royals died out of a strength of 1,098.† The officers lived in detached bungalows, and their mortality rarely exceeded 20 per 1,000.

The mortality for eight years in the force at Fort St. George, Madras, was 35 in 1,000,‡ 18 being by zymotic diseases; and 81, were constantly sick. For the latter four years the mortality was less than it had been. For 34 years the mortality at Fort St. George was at the rate of 40 in 1,000 annually.

5565. In Bombay and Colaba a return of one year exhibits a mortality in a small force of 59 in 1,000; for 23 years the mortality was at the rate of 63 deaths annually to 1,000 of strength at these fatal stations.

The other stations of the Presidencies of Madras and Bombay have hitherto experienced intermediate rates of mortality for the years for which the stational returns are supplied; the rates of mortality per 1,000 were at Hyderabad, 36; Kamptee, 35; Kurrachee, in Sinde, 34.

Stations on the Ganges.

Stations on the Ganges.

The stations in the basin of the Ganges present some peculiarities. That river receives in a thousand streams the waters of the Himalayas, and of the Vindhyan range of hills, besides the abundant rains that flood the plains in the wet season. Moisture and heat produce luxuriant vegetation, which feeds millions of animals, and the plain is inhabited by millions of men. Perhaps no river in the world has on its banks so many populous cities, which are in constant communication through the water, the air, the boats, and the stream of traffic on the roads. The low ground is subject to inundations, and the flood, as the banks of the river are high, is left to evaporate after its subsidence.

There is, then, in the plain of the Ganges, danger from malaria of the undrained lands, besides the various dangers generated

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* Report of Dr. Crawford in Army Medical Report for 1860, p. 320. It is here assumed that the annual deaths (63·76) which Dr. Crawford has given, express the rate of mortality per 1,000. If, as stated, those deaths occurred in a strength of 752·8, the mortality must have been at the rate of 85 in 1,000, and the total deaths in the 30 years 1,913.

† See the Evidence of Dr. Maclean, and the Report of Dr. Crawford, in the Army Medical Report for 1860, pp. 313–29.

‡ Strength, 825 for 8 years, 1847–54. *Vide* returns, pp. 735, 750, fol. ed.

in the barracks, in the canteen, in the bazaar, and in the city. STATIONS ON THE GANGES.

The delta of the Ganges is a great epidemic centre, and there cholera first took the form in which it ravaged the world.

The capital of India is still undrained, uncleansed, and unsupplied with fresh water; so its diseases are as fatal as some of the diseases of London in former times. The main artery of the commerce of Asia, the Ganges, does the same work as the Thames; it also carries down 236 million cubic yards of soil annually; it floods the land, and besides ships, its tides waft up and down the unburnt and unburied dead of the Hindoo population.

Fort William, as might be anticipated, enjoys no sanitary immunities, for the mortality of the infantry during ten years, within its walls, was not at the rate of 20 or 10, but of 102 per 1,000 for ten years! For long periods the mortality is cited at 69 and 58 per 1,000. At Dum Dum the mortality was 77; and at Chinsurah, the old Dutch settlement, 54 and 70.

These stations, and Barrackpore, are on the delta of the Ganges, where the invalids embark and recruits are landed. The Rajmahal hills offer superior sites for troops; and at Hazareebaugh, only 1,900 feet above the sea, the mortality was, amidst many unfavourable circumstances, 57, and during two years 34 in 1,000.* Upon ascending the river and 212 feet above the sea, but on a dead level, we come to Dinapore, where the mortality was 63 in 1,000; at Ghazeepore, still further up the river, the mortality was 47 in one year. For twenty-two years the mortality was 78 in Dinapore; for nineteen years 52 in Ghazeepore. At Allahabad the mortality is excessively high; at Cawnpore it was 91 in 1,000 for seven years. For twenty-nine years the mortality was 66 in 1,000 at Cawnpore. For seven years at Agra, 800 feet above the sea and 50 feet above the surrounding country, the mortality was at the rate of 42; for twenty years it was 48 in 1,000.

At Meerut, 800 feet above the sea and 100 feet above the country on the Doab, between the Jumna and the Ganges, the mortality of the infantry per 1,000 (816 for 10 years) was 45, of which 31 was by zymotic disease. Dysentery, diarrhœa, and cholera prevailed; ophthalmia was epidemic; apoplexy, and hepatitis, and alcoholism, implying hard spirit-drinking, were also fatal to the infantry at this station, where the cavalry, lancers and dragoons, (630 for 6 years,) died at the much lower rate of 20 in 1,000, or, exclusive of zymotic disease, 8 per 1,000. The mortality of the large force (1,777) at Meerut in 1860 was 11 in 1,000.

The mortality of Meerut was at the rate of 32 per 1,000 for 19 years; so that the mortality (44) of the next fourteen years, and of the infantry in 1847–56 (chiefly the 29th, 32d, and 81st foot) must have been due to some accidental disturbance.

All the Bengal regiments enter India at the Calcutta stations;†

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* In the year 1860 the mortality was at the rate of 27 in 1,000 (Army Medical Report for 1860, p. 114).

† Fort William, Dum Dum, Barrackpore, Chinsurah.

Stations on the Ganges.

and if through crowding, or any other cause, they contract zymotic disease, it follows them; for a regiment carries its diseases with it. Thus the 29th regiment of foot arrived in India on July 29, 1842, and it was stationed at Chinsurah, where it lost 106 men before April 1, 1843. Proceeding to Ghazeepore, it lost 158 men, and 260 men respectively, in each of the next two years. Its valour was not extinguished by disease; for 141 of the men were killed, and died of their wounds in the Sutlej campaign, and 48 in the Punjab campaign. These terrific losses were, however, exceeded at Chinsurah and Ghazeepore, before it had seen the enemy. This was one of the regiments which brought discredit on Kussowlie. It lost 1,061 men by death in India before it embarked for England on September 30, 1859. Its mean rate of mortality during the seventeen years was 95, or exclusive of the killed and of those who died of wounds, 86 in 1,000.

So fearful are the consequences of zymotic diseases in a regiment entering India.

In reasoning about the mortality of the stations higher up the country, it is necessary to bear in mind that regiments sometimes carry some diseases with them and with their camp followers from the stations below. Other illustrations of this principle will be found in the regimental returns, which, though imperfect, are invaluable.

Oude, the Cis-Sutlej District, and the Punjab.

Oude, the Punjab, &c.

Oude has been only occupied recently; but it is gratifying to find that in the year 1860* the mortality of the large force in some stations is not much higher than the standard: thus at Seetapore it was 18 per 1,000; Gondah, 20; Roy Bareilly, 23; Fyzabad, 32. At Lucknow the mortality was 27 in 1,000. The zymotic diseases and their obvious causes account for the excess over 10 in 1,000. The mortality of Allahabad and Cawnpore is reduced.

The stations of the Punjab were not always well selected, and they were necessarily, at first, in an unsettled state. The mortality was at the rate of 81 per 1,000 for infantry, 56 for cavalry at Lahore; 80 per 1,000 for cavalry and 56 for infantry in Ferozepore.

Upon leaving Delhi, the great road leads to Umballa, a large city on this side of the Sutlej, and thirty-five miles from the Himalayas around Simla. The station is about three miles from the city, and 1,050 feet above the level of the sea. The mortality during ten years (1847–56) was at the rate of 55 per 1,000; but the cavalry (dragoons and lancers) died at the lower rate of 23. The infantry fell from cholera, dysentery, fever, intemperance, and its sequels, sun-stroke and hepatitis. The 75th foot was the principal sufferer.

Crossing the Sutlej into the Punjab, the mortality before 1856 was, at Jullundur, among infantry, at the rate of 37; at Sealkote,

* Army Medical Report, 1860, p. 114.

OUDE, THE PUNJAB, &c.

27 among infantry, 13 among cavalry; at Rawul Pindee, 29. Excluding the zymotic diseases, which are sometimes due to removable causes, and often the result of causes to which the regiments were exposed elsewhere, the mortality of all these stations is reduced to 6, 12, 13, or 14 in 1,000. It is, therefore, not naturally higher than the standard.

In fact, the mortality in the year 1860 from all causes, was in Jullundur 7, Sealkote 13, Rawul Pindee 13, Umballa 15, per 1,000.

At the fortress station of Govindghur, near Umritsir, the holy city of the Sikhs, one death occurred in two years among a small force, where several, however, were attacked by ague.

The stations are at heights ranging from 900 to 1,500 feet above the sea level, and at some distance from the hill stations. The mortality at these elevations is not greater, therefore, than the mortality among British troops was formally in England; and we feel justified in adding, after carefully weighing the facts, is susceptible of being reduced to the English rates, under ordinary circumstances. The Sikhs are a perfectly healthy, vigorous race.

The mortality in Peshawur was at the rate of 61 per 1,000 of the mean strength for eight years. Fevers, dysentery, apoplexy, and liver diseases abounded, and of a mean force of 1,674 men, 193 were constantly sick, down to the year 1856.

STATISTICAL RESULTS.

We sum up briefly the results of this portion of the inquiry as follows:—

1. The English troops in India, by the returns of 1861, consisted of 8,324 officers and 76,684 non-commissioned officers and men, making in the aggregate an army of 85,008 men. The annual expenditure on the army of India has been at the rate of 100*l.* a man.

2. The mortality of the officers in India has hitherto been at the rate of 38 per 1,000, which is 28 higher than the English rate of mortality. Of the sickness there are no returns, but it is, undoubtedly, as excessive as the mortality.

3. The mortality of the non-commissioned officers and men during a long series of years has fluctuated, and has been on an average at the rate of 69 in 1,000. The mortality of men in England at the soldier's age is at the rate of 9 in 1,000. 60 in every 1,000 men were killed annually in India by the causes there in operation; the numbers slain in battle being few compared with the deaths by fevers, dysentery, liver disease, and cholera. About 84 in 1,000 men were constantly inefficient and in hospital, from the sickness induced by thousands of attacks of disease, including a large proportion of venereal cases.

4. The excess which has hitherto been observed in the mortality of India is in every station due to nearly the same zymotic diseases. These diseases were for centuries equally fatal in the cities of Europe. In Europe they are also still prevalent under the same circumstances, and they are generally most fatal in the summer,

STATISTICAL RESULTS.

when the sun is not so hot as in India, but is above the horizon a greater number of hours.

5. The experience of the civil service, of the military officers, of their wives and children, of the English troops in many stations, and of the native troops, proves that in the present state of India the mortality of the English troops there can be reduced to the rate of 20 in 1,000.

We have considered it necessary to enter into this lengthened analysis of the sickness and mortality affecting British troops serving in India, partly with the view of giving an authentic account of the facts with which we have to deal, but mainly to show the great importance of the subject to the public interests, and to enable us the more readily to ascertain to what extent this great sick and death rate can be diminished by known sanitary precautions. We next proceed to deal with this portion of our inquiry.

INFLUENCES AFFECTING THE HEALTH OF BRITISH TROOPS SERVING IN INDIA.

INFLUENCES ON HEALTH OF BRITISH TROOPS.

It will be seen, from what we have stated above, that out of the entire range of diseases to which European residents in India are subject, the diseases belonging to one single class, the zymotic, occasion by far the largest amount of mortality and inefficiency among troops serving in that part of the empire. It may be stated, in round numbers, that, at many stations, from one-half to two-thirds, or even more, of the deaths, and upwards of three-fourths of the admissions into hospital, proceed from this class of diseases.

If to these be added heat apoplexy, and liver complaints, frequently the consequence of certain forms of zymotic disease, we shall have included the main causes of premature and preventible mortality with which we have to deal.

Were it possible wholly to put an end to deaths arising from the various classes of fevers, from cholera, dysentery, and diarrhœa, together with hepatitis and its consequences, the troops serving in India would become as healthy as any body of men in the world.

The practical part of our sanitary inquiry, therefore, resolves itself into ascertaining the causes of these diseases, so far as it may be possible to do so, and determining to what extent we may reasonably hope to mitigate their virulence, if not to prevent their occurrence.

The problem is not peculiar to India. Zymotic diseases have always been the chief causes of mortality in uncivilized or imperfectly civilized countries, and they have been the special scourges of armies. If the vital statistics of all nations could be brought under review, they would testify to the fact that a great proportion of the ordinary every day mortality arises from some form of fever or bowel disease, increasing in severity during certain seasons and years; at times assuming the dimensions of pestilences known under the names of black death, plague, or cholera.

Whole regions of the earth which were formerly devastated by fever-pestilences and dysenteries have long since been free from them, except in the milder forms in which they now occasion part of the ordinary mortality. England, which suffered, at various periods, as much as other countries, has shared in this exemption; and, guided by the light of experience, we see no reason why India should form any exception to the rule, that in proportion as the conditions of health become better known and complied with, these diseases, the *opprobria* of imperfect civilization, should diminish both in frequency and in malignity.*

Science has hitherto failed to discover the special cause of epidemic diseases. These diseases are observed to occur in very different degrees of intensity at different periods, amongst groups of population exposed to certain unhealthy conditions. Sometimes they take the form of pestilences, and immediately afterwards, the conditions remaining the same, they subside and all but disappear, again to renew their ravages at some future period.

The great difficulty of reducing their phenomena under any general law formerly led many persons to doubt the practicability of diminishing their prevalence; but a more rational mode of inquiry, pursued chiefly in this country, has led to the discovery that, assuming the oscillation in intensity simply as a fact, there are certain well-defined conditions which influence most materially, not only their intensity, but also their frequency.

One of the earliest discovered of these facts was, that intermittent fever disappeared from places which it formerly ravaged after drainage of the soil and improved cultivation.

It was next discovered that by cleanliness, fresh air, and diminished crowding, the very worst forms of pestilential fever, which used to commit ravages similar to those of plague, disappeared entirely from English gaols.

Fevers of the typhoid and continued class, and various forms of bowel diseases, have been greatly diminished in frequency and severity by drainage, by improved domestic arrangements for removing human excreta safely and rapidly away from dwellings, by increased space and better ventilation.

Under improved drainage and other sanitary arrangements, fevers of the remittent type have almost ceased to exist in certain localities where they formerly prevailed.

Cholera and dysentery are now well know to depend mainly for their frequency and severity on the neglect of known sanitary precautions; and so intimately are these diseases connected with the condition of the water supply, that while an epidemic prevails, the question whether a given population shall suffer or escape may almost be predicated by a chemical analysis of the drinking water.

So far as the experience of more temperate climates can be admitted as evidence, it tends to prove that the very class of diseases, formerly so fatal in this country, and which has occasioned

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* *Vide* Note on the Diseases of London, [p. 144 *post.*]

Influences on Health of British Troops.

so very high a rate of mortality, both absolute and relative, among the Indian army, is, to a large extent, dependent on removable conditions and habits.

In pursuing our inquiry, we have received much evidence of great value and importance from witnesses practically conversant with the sanitary state of the troops in India, and we have besides endeavoured to obtain an accurate account of the sanitary state of every military station in India and its dependencies, by the printed questions already mentioned, addressed to commanding, medical, and engineering officers at each station.

We have included in this part of our inquiry local topography and climate; the sanitary condition of cantonments, barracks, hospitals, bazaars, and neighbouring native towns; the source, quality, amount, and means of distibution of water supply; the diet, drink, clothing, accoutrements, duties, and recreations of the soldier, together with the observed effect of all of these conditions on his health. From the replies received to our questions, and from reports of inspecting medical officers, we have been enabled to collect a large amount of most valuable data, which not only throw much light on the subjects of inquiry committed to us, but which, we believe, will be in other respects of great use to the public service.

In dealing with the evidence before us it is necessary to bear in mind that the soldier's health in India, as elsewhere, is the product of all the conditions to which he is exposed. It is not solely the result of climate, nor of locality and dwelling place, nor of diet, habits, nor duties; it is the product of all of these. Some of the conditions to which the soldier is exposed are irremovable, and some admit of being modified or removed. To what extent this can be effected is, indeed, the main practical object of our inquiry.

Topography and Climate.

Topography and Climate.

4289.

India extends over 26 degrees of north latitude. It has a superficial area of 1,500,000 square miles, enclosed on the north, east, and west by gigantic mountain ranges for 4,500 miles, and along its southern, eastern, and western sides by 4,500 miles of tropical seaboard.

Much of the country consists of plains traversed by large rivers, having deltas projecting into the ocean, and hardly raised above its level. In other parts there are extensive table lands of greater or less elevation, rising from the plains below. Along the west coast there is a continuous range of mountains, intercepting the warm moist winds coming from the Indian Ocean, and influencing the climate for a considerable distance inland. Here and there are solitary mountain groups of varying altitudes, from 3,000 to 5,000 or more feet, presenting, from their elevation, very different climates from those of the plains within sight. The northern barrier of the Himalaya consists of a succession of ranges, increasing in height as they recede towards the north, until they attain altitudes of from three to five miles.

According to the popular notion, the mortality of the British in India is explained by the heat and strangeness of the climate. Hot climates are believed to be hostile to human life, and to be especially deadly to the English race. In the West Indies, on the Coast of Africa, and in India, the forces have been at intervals decimated by epidemics, through the century that England has held possessions within the tropics, and the climate has always been blamed.

So much has been attributed to its influence in India, that we considered it necessary for our inquiry to place the documents at our disposal in the hands of Mr. Glaisher, who has for the first time given a comprehensive view of the geographical distribution of atmospheric phenomena over this vast and various peninsula.

India, according to Mr. Glaisher, enjoys in its temperature perpetual summer on the plains; it has there no frost or snow; the heat, however, is as excessive there in some months as the cold is in Europe in others; and rain is as abundant in the rainy season as it is frequent through the year in England. He shows that the observed elements of climate vary with the latitude, longitude, and elevation; that there is higher temperature and a much larger amount of dissolved water in the air than in England, although the relative amount of moisture to temperature is less in India. But as far as relates to the influence of moisture on health, the actual amount of dissolved water may be taken as indicating the amount of organic matter in the air, of which water is the solvent and vehicle; and hence, although the relative amount of water in the air in India is less than it is in England, the atmosphere, considered in relation to the effect of humidity on health, is more humid than it is in England.

The sensible effects of climate in India vary as widely as the physical characters of the country. On the plains and deltas the climate is hot and moist with considerable rain-fall. In the southern parts of India there is heat and dryness. On the mountain ranges the temperature falls with the elevation; and at certain altitudes diminution of heat is accompanied by a perceptibly moist condition of the air. Along the face of mountain ranges exposed to the monsoon, there is an excessive rain-fall, to be measured by feet rather than by inches, rendering the country almost uninhabitable for the time of its duration; while within a short distance to leeward the atmosphere is dry and clear, with little rain. The climates of the seaboards vary with the direction of the wind. Sometimes they are comparatively cool, while at others they are warm, moist, and depressing. The climates of certain isolated mountain groups and table lands are almost as healthy as those of Southern Europe; while at the base of the same mountains there are local climates, which are absolutely pestilential.

At the majority of the stations occupied by British troops there is a high mean temperature, accompanied with much dissolved moisture. At many of them there is a considerable difference between the day and night temperature, accompanied by night

Topography and Climate.

and morning fogs, and by a feeling of coldness succeeding a high temperature during the day.

Heat, moisture, and variation between night and day temperature are the three special climatic conditions to which the soldier in India is exposed, and except in so far as the degree of humidity is the result of local defects in drainage, these conditions cannot be changed, unless by resorting to mountains or table lands as sites for military stations.

Such being the case, it is very important to consider—what amount and kind of influence these climates are likely to exercise on the soldiers' health? In dealing with this important question we are struck with the absence of direct allegations against climate in the stational reports. Although most of these reports contain statements more or less specific as to the effect of particular seasons on the amount of disease, the reporters do not attribute the soldiers' mortality to the climate of the stations. Other causes are usually assigned. This negative evidence is of great importance as against the common opinion regarding the fatal character of Indian climates. It is nevertheless certain that climate does exercise some effect on the general health of persons exposed to its influence. Experience shows, first, that long-continued exposure to Indian climates gradually deteriorates the constitution; and, secondly, that diseases of the epidemic class prevail most severely and extensively in localities where, and at seasons when, the elements of heat and moisture most predominate. If careful inquiry were to show that there were absolutely no other agents at work in producing these results except high temperature, then we should be driven to the conclusion that nothing short of change of climate and station would preserve the health of the army. But as we shall presently show, there are many other agencies at work besides those due to climate *per se;* and first among them we must place that subtle, unknown agent, or rather that cause of disease, known only by its effects, malaria.

At all the stations of India from the Himalayas to Cape Comorin the presence of malaria can be traced by its influence on health. It is the chief cause of periodic fevers and certain forms of marasmus and spleen disease among the native population. It underlies the cause of many other diseases, and it appears to exercise a powerful influence on the course of epidemics of cholera. It is most intense in its operation in low, warm, moist localities, where there is a superabundance of vegetation and water, and it also shows its presence in dry situations, where these conditions are apparently wanting. At considerable elevations, where the air is cool and dry and the vegetation scanty, it diminishes greatly or disappears altogether. It is the product of heat, moisture, and vegetable decomposition. It appears to be absorbed largely and retained by the soil, and is given off on the first fall of rain or on turning up the ground, in sufficient intensity to produce disease in susceptible persons exposed to it. In districts where it exists, anything which retards a free circulation of air, such as jungle,

forests, high walls, or similar impediments, adds to its force. And on the other hand, everything which tends to lower the standard of health of persons exposed to it increases their susceptibility to its influence. This malaria is universally believed by the natives of India to be conveyed in the drinking water.

The production of malaria can be checked by withdrawing any one of the three elements, on the co-existence of which it depends; but the experience of colder climates would appear to prove that subsoil water has more influence on its production than high temperature. High temperature, with a moist state of the air and subsoil, are the chief agents which influence the rapid decomposition of dead organized matter, while at the same time they produce a certain amount of susceptibility to disease in those exposed to them. Indian climates have therefore the double disadvantage of generating malaria and increasing its deleterious influence on health.

Whether it may ever be possible to banish this scourge from the soil of India it is hardly within our province to inquire, and the question could hardly be answered; but it is satisfactory to know that it has everywhere disappeared before clearing, subsoil drainage, and improved agriculture, changes which involve the removal of all excess of decomposing organized matter, and of water, the main element of decomposition; by which, moreover, the soil is repeatedly exposed to the action of the air, and brought under the influence of living vegetation. Part of the deadly terrai of Northern India has become comparatively healthy by clearing away the forest and cultivating the soil. 5456.

Considered with reference to its effects on particular stations, the extent to which malaria prevails appears to depend very much on the physical constitution of the surface and subsoil. The terrai, where it is most fatal, is a belt of country of greater or less breadth, situated at the foot of mountain slopes, formed to a great extent of débris, receiving and retaining a large amount of water from the higher levels, and covered with a dense vegetation, which, in the course of ages, has formed a rich, deep, vegetable soil.

In river deltas the conditions are somewhat similar, for they also are formed of débris and vegetable mould covered with vegetation and saturated with water.

The low banks of rivers, along which the subsoil becomes infiltrated with water, reproduce similar conditions.

Retentive soils, having imperfect natural drainage; expanses of shallow partially dried-up water; neglected tanks; hollows filled with water; marshy ground, and damp or wet ravines, are all well-known sources of malaria in India.

There are also porous soils which retain a large amount of moisture by capillary attraction apparently. To this class appear to belong the red earths and decomposed mountain rocks, especially granites; but the most common cause of the anomaly of porous soils giving off malaria is the existence of retentive beds below them, keeping water at no great depth below the sur-

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face. In some anomalous cases of this kind impure drinking water may possibly be an overlooked cause of disease.

A certain physical configuration of the surface, marked by the presence of valleys running up mountain slopes from the low country, is a cause of malaria being carried up mountain districts for thousands of feet above the terrai where it had its origin. Mr. W. Elliot states that he has seen several instances of this.

4258. In one such case a whole family living in an otherwise healthy locality was swept away by malaria rising from the low country. He says that a mist is seen rolling up the valley with the breeze, and that the malaria is taken up in that way. It is hardly necessary to insist on the value of this experience as affecting the choice of stations even on the hills. But the importance of these and similar facts was not recognized when stations were first occupied, and many of them were placed in deadly localities, which had in the end to be deserted after great cost had been incurred in their formation.

In the present state of Indian drainage and agriculture it is clear that for all practical purposes we must assume the three peculiarities we have enumerated,—heat, moisture, and malaria,—as constantly present and everywhere influencing the sanitary condition of the country. These are ever tending to lower the general standard of health, and to predispose to epidemic diseases, but they are by no means the only causes in operation, although they exert a potent influence on the comparative intensity of other causes. The presence of any or all of them has the effect of rendering other causes of vastly greater importance than they would be *per se*. Negligence, or the absence of precautions, which in cooler climates would lead to little or no result, good or bad, become of great importance in India. A trifling degree of impurity of the air, brought about by a stagnant state of the atmosphere, or by overcrowding and want of ventilation in a barrack or station, may lead to a fatal outbreak of disease. Impurity in the water supply, such as would be attended with comparatively little influence on health in England, may, in India, determine an endemic attack of cholera or dysentery. Some apparently trivial inattention to cleanliness or drainage, of every day occurrence at home, may lead to disastrous results where a number of men are crowded together on a small area.

Personal habits, indulged in with impunity in this country, send men in large numbers to hospital in a climate where personal hygiène is as important as is public hygiène to the interests of the State.

In short, the whole sanitary question as regards India must be considered from this point of view, not only by the Government but by commanding and medical officers. The supreme importance of apparently trivial causes of disease is the lesson to be learned by all our past experience, and not till this is thoroughly understood and practically acted on will any great good be done in reducing the high mortality rate of the Indian army.

Topography and Climate.

The evidence given before us by numerous witnesses, and also that contained in reports from the stations, clearly show that European troops during the period of their service in India are exposed to very important conditions besides those arising from climate.

We shall begin the consideration of the various influences affecting the health of the European soldier in India by a brief general statement of the nature of his service.

Recruiting and Passage out.

Recruiting and Transport.

Dr. Duncan Stewart, surgeon to the recruiting depôt for the Indian army at Warley, states that the usual recruiting age lies between 20 and 35 years, and that it differs in the different arms of the service, but that a great many have entered under 20. 599.

Recruits from all parts of England were assembled at Warley, and sent to sea in detachments of from 200 to 350 men. 605. It was the custom for men to enlist for particular arms of the service; but sometimes they were transferred at the depôt from one arm of the service to another. On arriving at Warley they were carefully drilled under cover. At first they suffered from change of habits, diet, &c., and there generally was an average of about 6½ per cent. sick in hospital. Notwithstanding every care in selection, men were sometimes sent back from India as unfit for service. The average time spent in depôt before the mutiny in 1857 was four months. 610. At the time of the mutiny it was about six weeks; and it happened occasionally that men were embarked for India on the day of their arrival at Warley.

The troop ships are stated to have been always good and specially ventilated. 625, 6. It used to be the custom to pay head-money on those landed in India. This has been discontinued, but, so long as it existed, the practice made it directly the interest of the medical officer to attend to the sanitary condition of the men.

Of late years a special code of instructions for troop ships has been in use; and no doubt great attention has been latterly paid to the health of the men while at sea.

One very injurious practice until very lately existed in permitting the issue of spirits during the voyage, and even the latest Queen's Regulations require no more than that the spirit should be mixed with three parts of water, and not issued till after dinner.

There are three points which require notice in this system of recruiting:—

1. Many of the men are exposed to laborious duties in a tropical climate at too early an age, and before the constitution is fully formed.

2. The period of drill is in any case too short, because it necessitates completing drill after the men arrive in India, and all the dangerous fatigue and exposure consequent on it in an Indian climate.

RECRUITING AND TRANSPORT.

821. Deputy Inspector-General Stewart has pointed out the necessity of greater attention being bestowed on these conditions of a soldier's service. He states that no man ought to go out to India under 20, or from that to 25; and this opinion is supported by a great amount of testimony contained in the reports from the stations. Dr. C. Smith states that for the first few years of service men are very apt to suffer from fevers and inflammatory diseases, partly from greater constitutional liability, partly from inexperience in the case of young soldiers arriving in India, who take no care of themselves at all. Sir A. Tulloch is of opinion that recruits might be enlisted at 18, provided they had two or three years' training in a temperate climate before being exposed to a tropical climate or to the fatigues of a campaign. All the evidence derived from the stations is to the effect that none but fully drilled soldiers should be sent to India. The only question on which any difference exists is the place where the troops should be drilled. It has been proposed that the drill should take place at some intermediate station, as, *e. g.*, at the Cape, for the purpose of accustoming the recruit by degrees to change of climate. But the great preponderance of the evidence is in favour of completing the drill at home, and sending the soldier fully formed both as to age and habits, direct to his destination.

Vide abstracts of stational reports.

1607, 8.

5556.

Vide abstracts.

4458, 9. From want of attention to these primary conditions, growing lads, who are very susceptible to disease when weakened by fatigue, have been sent out to India to learn their drill; their unformed constitutions are exceptionally liable to injury, and the over-zeal of an injudicious commanding officer or adjutant may lead to loss of health and efficiency, if not of life.

We have here, then, a well-known preventible cause of disease, or rather of predisposition to disease, which can be put a stop to. It is true that under the altered circumstances of the army since the amalgamation of the two services these evils will be less likely to occur; but, anyway, the past experience is sufficient to prove that they should be avoided in future.

3. As regards the issue of spirits on board ship, there cannot be a doubt that the practice has been injurious to the health of the army. It can easily be understood how this arises, when it is considered that men, having little or nothing to do during a three or four months' passage, may gradually contract a taste for spirits which they never had before; and of course, immediately on arriving in India, they proceed to indulge themselves with any kind of intoxicating drink they can most easily obtain, so that on their first arrival in a dangerous country the habit acquired on board ship may lead, as indeed it has led in a great number of instances, to the destruction of health and life. Lately an issue of malt liquor has been made on board ship, but still the Regulation allowing the use of spirits is in existence, and ought to be repealed.

Queen's Regulations, 1859, pp. 338 and 360.

3530–46. An issue of malt liquor, cheap light wine, or temperance drinks, tea, &c. is recommended by Dr. Bird. On board many ships in the mercantile navy the issue of spirits and beer has been altogether

discontinued, with great benefit both to health and duty; and the example is quite sufficient to show that spirits at all events are not amongst the articles of a soldier's ration on board ship which are indispensable either to his health or comfort.

In former times little or no attention used to be paid to the season at which troops were landed in India, and it was mere matter of accident whether or not their first introduction to an Indian climate was at the healthy or most unhealthy period of the year. On landing at any of the presidencies no efficient precautions used to be taken in the way of dress, diet, or accommodation, or for preventing the men from falling into intemperance and dissipation. After landing they were forwarded to their destination without much regard to season or means of conveyance. Not unfrequently, when boats were used, they were overcrowded, badly ventilated, and otherwise insufficient for the purpose, and fatal epidemic attacks used to decimate the troops on board. These great evils have of late years been gradually abated to a considerable extent under Lord Ellenborough's administration, as stated by Col. Durand; but we think it right to mention their existence, because they in some measure account for part of the greater susceptibility to disease and the much higher rate of mortality which formerly existed in the Indian army. At the present time we believe that troops are as far as possible landed at the beginning of the cold season, that they are much better cared for now than formerly, but that even at present there is great risk on their first landing, from facilities for intemperance, which perhaps might be avoided, to a great extent at least, by additional care. The present practice is to forward troops direct from the port of debarkation to their regiments. 5093.

Where railways exist they are made use of; water conveyance is generally by means of well-appointed steamers, or a better description of country boats: and where neither of these means is available, the troops are conducted by short marches in the early morning.

The present practice is hence a great improvement on the former one, and has been attended with corresponding improvement in the health of troops.

DUTIES, &c.

The soldier's duties at stations consist of the usual guards, of drills and parades before sunrise or at sunset, and are described by Colonel Greathed as follows:—

"At gunfire he goes to parade, and, as a general rule in barracks, he gets his breakfast at eight o'clock; at half-past ten he parades again in the barrack, when the officers go round the barracks to see that they are clean. Then there is a roll-call again at dinner-time, and a roll-call at evening parade; then he has his supper. After that time he is free till tattoo, which is at eight or nine o'clock, according to the season. There are roll-calls during the night in all barracks, if men are supposed to be absent; it is done by the serjeant-major, and that is by what is called the check-roll, and if there are two or three men absent the check-roll is called. 3252.

Duties, &c.

"3253. Does not that mean that the whole barrack is disturbed?—Yes; but it does not often happen.

"3254. For how many consecutive hours is the soldier on guard?—For 24 hours.

"3255. Does the practice in India differ from the practice at home in that respect?—No.

"3256. How many nights a week is a soldier in bed?—It varies occasionally; he is from 13 to 15 nights in bed very commonly; that is to say, that he does not come on guard above once in 13 or 15 days.

"3257. You mean that he is 13 nights in bed for one night out?—Yes.

"3258. Do you think that the amount of duty performed in India is greater or less than that which is performed in England?—It is less; there are no fatigue duties, or very few, compared with what they have in England; for instance, the fatigue duties of sweeping out the barrack-rooms, cooking, and carrying dinners to the men on guard, which is the most cruel thing upon the men at home, of all the duties thrown upon the soldier. That the soldier has nothing to do with in India, because his cook always goes with him."

As far as concerns his duties, the soldier cannot be said to be exposed to excessive fatigue if the Regulations are strictly complied with. But there are complaints that troops are sometimes unnecessarily subjected to duties after sunrise, and (as already mentioned) to drills. In this, as in other things connected with
5142, 3. the soldier's duties and habits, Col. Durand states that "a great "deal depends on the wisdom of the commanding officer: the "wisdom of the commanding officer is really a thing of very "immense importance in India, for almost everything is in his
Stational Reports. "hands." Evening drill is complained of, apparently because it comes after dinner, so as to interfere with digestion. There is a concurrence of testimony to the fact that night duties, even in that climate, hardly ever act injuriously on health.

Acclimatization.

Acclimatization.

We have already shown, statistically, the influence of length of residence in India on the rates of mortality among soldiers. But there has been considerable difference of opinion as to the effect of acclimatization on the health and efficiency of troops. It has been stated, on one hand, that men get accustomed to the climate by length of residence, and hence that there is hardly a period, so far as health is concerned, to which their term of service should be limited.

Others again have arrived at an opposite opinion, and one much
1293. more in accordance with observed fact. Dr. John McLennan, when asked whether a man of one year's service or of ten years' service would be the more able to endure fatigue and exposure, answers, "The fresh man decidedly."

3303. Col. Greathed says, "I believe that the medical officers will "say that the longer a soldier remains in India the worse he "gets. And I believe there can be no doubt of it; I do not
3304. "believe in acclimatizing." "For the first five or six years a "soldier is a very good man indeed in India, but after that he "begins to break down, and he is not so good a man as he was."

159. Sir Ranald Martin states that all statistical observations go to disprove anything like acclimatization in the East Indies. On the

ACCLIMATIZATION.

contrary, he says, disease and death increase with length of service and age.

The opposite opinion seems to have arisen partly from the circumstance that some men have learned by experience the art of managing themselves, and so of preserving their health in unhealthy districts, and partly from confounding the effect of heat and moisture (*i.e.*, climate) with that of local sanitary condition. 3634.
There *is* "acclimatization" to heat; there is none to "endemic "miasmata."

Vide abstracts.

The whole tenor of the evidence in the stational reports is against the doctrine of acclimatization, as generally understood, and in favour of limiting the period of service in India to about 10 years. It does not, however, necessarily follow that this limit need be maintained, if the sanitary condition of the troops be improved, as it may be.

CAUSES OF DISEASE.

CAUSES OF DISEASE.

Following up the history of the soldier after his arrival in India, we next proceed to inquire into the condition of the stations where he serves, his barracks and hospitals, his habits and pursuits, dress and diet, in order to ascertain whether (and, if so, what) unfavourable conditions are superadded to those attending on his recruitment and introduction to service, which can account for the high rate of inefficiency and death shown by Indian statistical returns.

In the course of the inquiry we have collected a large mass of most important information on all these points. But before discussing it, we shall give the general results of the evidence, showing the nature of the causes of disease which have arrested the attention of different observers, beginning with those which are incidental to the climate and country.

Sir Ranald Martin states that "taking any one cause, he should 129.
"say that the union of heat, moisture, and malaria constitutes the "most powerful one in destroying the integrity of the European "soldier's health, and conducing to his fall by disease." And he goes on to state that "a certain amount of destruction and deteri- 130.
"oration of European health must result from a residence at the "stations on the plains, even if the soldiers were put into "palaces."

But while laying this down as a fundamental sanitary principle, 132, 3.
he says, at the same time, that there is a very great difference between the health of the officer and that of the soldier, always in favour of the officer. And that there is also a difference between the health of the officer and that of the civilian, always in favour of the civilian.

We have thus three classes of Europeans exposed to the same 134.
conditions of heat and malaria, presenting three quite distinct rates of sickness and mortality; a fact which indicates the existence of other causes of disease, operating with different degrees of intensity in each of the three classes.

CAUSES OF DISEASE.

Dr. Falconer considers excess of heat and excess of moisture as among the irremovable causes of disease in India, and as those which tell most upon the health.

5479.

1520. Dr. Colvin Smith attributes the largest amount of injury to a malarious climate. But, then he adds to this, as of equal importance, intemperance and syphilis; and he says, "these are the "three things which generally break up the constitution of a "man in India."

3592. Dr. James Bird says that pure liver disease, and that accompanying dysentery, are produced by the predisposition caused by a high temperature, followed by cold.

1226. An opinion similar to that expressed by Dr. C. Smith, as to the prevailing causes of disease, is entertained by Dr. John McLennan, who attributes the largest amount of injurious effect on the health of the soldier to climatic influences, intemperance, and sexual disease.

This evidence, which contains the opinions of men of great experience, implies only that these causes, all but one of which are removable, lower the stamina of the body, cause ill health, and predispose to, and under certain conditions induce, disease. But all the witnesses admit at the same time the existence of other very potent causes which, although not incidental to the climate, are nevertheless rendered of greater importance by it. Even with

3635. regard to the presumed irremovable cause, malaria, Dr. James Bird states that miasmatic influences are removed by hygienic

3653. measures, in India as in England; and he cites, as a strong proof of this, the case of Batavia, in which, by the effects of Dutch sweeping, cleaning, and draining, the most deadly city in the world had become a healthy and agreeable residence.

3654, 5. He states that miasmatic emanations had been removed both at Cadiz and Gibraltar, and he sees no reason why similar results should not be obtained in India.

All the other causes of mortality assigned by the various witnesses belong to the class which, in this country, are considered as removable. We shall state these generally and discuss them afterwards in detail. Some of them are connected with locality, others with defective barrack accommodation, and the remainder are attributable to bad habits or exposure on the part of the men.

99. Sir Ranald Martin states, in regard to epidemics, "of all the "causes which go to foster and maintain epidemics, the ill selec- "tion of localities, the structural defects as to ventilation, drainage, "cleanliness, and the personal habits of the soldiers, are the im- "portant questions."

1221. With reference to outbreaks of cholera, Dr. John McLennan states that this disease is known to have a certain connexion with damp and moisture, imperfect drainage, impure water, improper articles of food, close badly-ventilated sleeping places, and generally with what may be termed a bad sanitary state.

4483, 4. Referring to dysentery and cholera, Surgeon-Major Grant says that, in his experience, the most influential cause of these diseases is overcrowding in barracks; and that in gaols he has observed the

most appalling mortality from bad air. Even at hill stations, far removed above the influence of malaria, he attributes the prevalence of diarrhœa to neglect of ordinary sanitary arrangements. He also says that bad water is a common exciting cause of cholera in India. 4523.

Dr. James Bird states that— 3589.

"Diarrhœa, dysentery, and fevers have prevailed, and have been attended with great mortality" at stations at which he has served, "from want of due precaution in the selection of sites. Cholera, as an epidemic, appears mainly to owe its development and origin to miasmata, favoured by elevated temperature, and peculiar atmospheric conditions of climate; this development being greatly aided by preceding established conditions of filthy endemic situations, badly-constructed and ill-ventilated habitations, unhealthy articles of food and drink, producing predisposition to disease, aided by unhealthy trades, and depraved moral conditions of vice and poverty. The other diseases are mainly local, and miasmatic in their origin."

The evidence shows that the local causes of epidemic disease in India are precisely the same as those which exist in this country, aggravated by a higher temperature and by the presence of malaria.

Personal habits, as before stated, have more to do with health in India than at home. Many indulgences, which are comparatively innocuous in a cold climate, especially those connected with diet and regimen, become of serious consequence to health within the tropics.

Sir John Lawrence states that both men and officers are careless in these respects, and that their habits of life are very inimical to health; that the habits of a cold climate are extremely pernicious in India, and soon produce bad health and an increased mortality; that the men eat too much animal food, eating it sometimes twice or three times a day, irrespective of season or temperature; and that he thinks the Government might try to induce the men to use more vegetable diet in the hot weather. 2941. 2942–6.

Dr. Maclean considers that the habits of life of the European soldiers are very unfavourable to health, for undoubtedly they are very intemperate, and they suffer much from ennui and want of occupation. 2354.

Referring to the sources of disease within the tropics, Sir A. Tulloch says that he is disposed to regard idleness as one of them, and that the men would be more healthy if worked more. 5551.

And Staff Surgeon McCosh states that in his opinion soldiers in India do a great deal too little for themselves; that anything that would keep them out of idleness and out of the grog-shops would be conferring a benefit upon them, and that they are never so healthy as when undergoing the fatigues of a long march. 2686.

The causes of disease, described very generally in this evidence, are those connected with the selection of stations, the sanitary condition of stations, barracks, and hospitals, bazaars and native towns, the condition of the water supply, intemperance, and venereal disease, diet, occupation, and the want of means of instruction and recreation.

We now proceed to consider each of these in detail.

Sanitary Condition of Stations, Towns, and Bazaars.

Sanitary Condition, &c.

Important information regarding the topography and diseases of all the stations will be found in the stational reports, and in the abstract. We refer to these for details, and propose to introduce here a few examples only, illustrative of the general condition of stations.

Many of the stations occupied by British troops are either within or close to cities and towns, the inhabitants of which are decimated periodically by fevers, cholera, diarrhœa, and dysentery, connected with the most obvious local causes. The troops occupying this class of stations are exposed to any sanitary defects incident to the civil population, and suffer more or less from the same diseases.

Other stations, known to be unhealthy, have been selected from time to time apparently for military or political reasons.

2233. Referring to those in the Madras presidency, Deputy Inspector-General Maclean states that they were selected without any special regard to medical considerations, and that many of them were occupied merely because they happened to be the spots where the troops first pitched their camps on taking possession; that the nature of the soil, the water supply, and malaria were never thought of.

6, 7, 8, 9. Sir Ranald Martin says that stations have been selected without care; that no station he has ever visited was exempt from malarious influences; that the soils are damp, the situations low and ill drained, the surface irregular, the ground jungly, and some of the stations subject to flooding.

1024. Captain Nicolls of the Madras Engineers, describes the stations on the plains as all of one description, the country being flat, with very slight undulations, just sufficient to carry the water into the nullahs; the hill stations being situated on a ridge or spur of a hill.

6. Many of the old stations have proved so extremely unhealthy that they have had to be given up, after having entailed a great loss upon the service. More care has been bestowed of late years

2924. in the selection of new stations. Some of these, Sir John Lawrence states, have been extremely well selected; some very badly selected; there is a great difference in them.

The difference as regards health is due to the nature of the country and to the position and comparative elevation of the station itself. The sea-side stations are, of course, all at or very near the level of the sea, and have the great advantage of the sea breeze; but this advantage has been neutralized by a site having been chosen close to some muddy tidal estuary, as at Vizagapatam; or the sea breeze has been cut off from the barracks by a high wall, as at Madras, until the wall was lowered by Sir Charles Trevelyan. The low country stations in the Bengal presidency are only a little elevated above the level of the sea, following in this respect the level of the river. Fort William, one of the largest and most unhealthy of the stations, although 67 miles in direct distance from

the sea, is only 18·16 feet above its level, and only one foot above mean high water in the river. Dum Dum is 84 miles from the sea. It is 18 feet above mean tide level; but during the S.W. monsoon it is only two feet above the level of high flood tide; at this time the ebb and flow of the tide is visible in the ditches at the station. Berhampore is 76½ feet above the level of the sea, but it is three feet below high water mark in the river. Allahabad, an unhealthy station, situated at the junction of the Ganges and the Jumna, is 368 feet above the sea, and about 40 feet above the surrounding country.

The N.W. stations are at a considerably higher elevation. Rawul Pindi is about 1,500 feet; and the large station of Mean Meer is 1,128 feet above the sea.

Secunderabad, in the Madras presidency, has an elevation of 1,800 feet. Bangalore, which is the highest of the larger stations in India, is 3,000 feet above the sea level. Belgaum, in the Bombay presidency, is about 2,200 feet, and Poona is 1,800 feet above the sea.

Many of the most important stations are thus at a healthy elevation above the sea level, if the sanitary condition of the station were determined by this element. But they are all more or less deficient in another element of perhaps greater importance, viz., their relative level as regards the surrounding country. Generally speaking they are little if at all raised above that level; and sometimes, as is the case with the highest of them, Bangalore, part of the station is actually below that level. Some of the most unhealthy stations are close to river banks.

In the great majority of stations, water is found at a short distance only below the surface. The only means of arriving at an estimate of the depth is by the wells; but as water is being constantly drawn from them, they do not afford a very accurate indication of the water level in the subsoil. Thus at Fort William the water level varies in depth from 12 feet in the dry season, to 2 feet in the wet season, although the ground is at all times close upon the water level in the river. At Dum Dum the water level in the dry season is at a depth of 9 feet, and during the wet season of one foot from the surface. At Kirkee, the depth is at 33 feet in the dry and at 19 in the wet season. And so of the others.

As might be anticipated, the soils and subsoils vary very much. A few stations are situated on dry sandy soils. In others the underlying rock comes close to the surface. But in the majority the soils are more or less retentive of moisture, and charged with decaying vegetable matter, and damp.

The natural result of this in a warm climate is the production of malaria. It is by no means certain, however, that this malaria exists equally over extensive tracts of country. There is on the contrary reason to believe that, like every other local cause of disease, it is much more intense in some districts than in others. Some years ago, a committee was appointed to examine the effects of irrigation on health; and one of the most important facts elicited

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by the inquiry is stated by Deputy Inspector-General Dempster to have been the close proximity of some of the worst and some of the best localities. And applying this discovery to such stations as Cawnpore, Kurnal, Dinapore, Delhi, Ghazeepore, he says that nearly all these stations are irremediably vicious; but, nevertheless, he believes that good localities exist at no great distance from every one of them.

Although, as has been already stated, more care has recently been bestowed on the selection of stations, this important duty is not conducted on any fixed principle. No specially competent class of officers has been appointed for the purpose. A Committee is usually constituted of a commanding officer, an engineer, and a medical officer, with certain additional members, who proceed to make the necessary inquiries, and report. No doubt the intention is to obtain the best practical advice and opinion, but very special knowledge is required for such a purpose, while the consequences of mistake may be so disastrous that any mere chance selection of officers for the duty should be avoided. The Committees should either be constituted entirely of men of known competence; or else certain officers specially conversant with the whole subject should be selected for this particular service, and placed as *ex officio* members on all Committees. Officers should never be taken for such a service by roster; nor should officials on the spot be entrusted with the duty merely because they happen to be there.

The selection of new stations should in short be considered as one of the most important sanitary duties, and should be a recognized part of the sanitary service of the army.

We next proceed to consider the sanitary condition of existing stations as it bears on the health of the troops. But in doing so it is necessary to include the sanitary state of native towns and bazaars, because not only is a part of the soldier's time spent in these places, but the mere fact of their proximity to European barracks must necessarily exercise an injurious influence on the healthiness of both barracks and hospitals, if the native dwellings are in an unwholesome condition. It is indeed impossible to separate the question of health, as it relates to troops, from the sanitary condition of the native population; especially as it regards the occurrence of epidemics, which, whenever they occur among natives, indicate a condition of matters dangerous in the highest degree to the troops in the neighbourhood.

5314. Referring to this subject, Sir Ranald Martin says, that when he was surgeon of the native hospital at Calcutta, he was always aware of the advent of cholera 15 or 20 days before it attacked the European population, by its prevalence among the natives, and that this was one of the reasons which led him to suggest sanitary improvements for Calcutta. The bad sanitary condition of this large city is indeed so notorious that Deputy-Inspector General Longmore, who acted as sanitary officer at Calcutta during the mutiny, does not consider it necessary to describe it. He merely states that, as regards the chief part of the vast area covered by the

2138, 2146, 2147.

city, that inhabited by the native population, the pestilential condition of the surface drains and yards, and many of the tanks among the huts and houses, would not be credited by any one who had not been among them. The influence in certain winds of these places is quite perceptible at Fort William, although there is a very good esplanade between the fort and the bazaars. He has no doubt that there would be much more mortality among troops, were it not for the esplanade.

This great city has grown up by degrees in the entire absence of any efficient sanitary supervision. There has hitherto been no proper drainage. The water supply has been defective and bad; and the houses are much overcrowded.

The sanitary condition of the town of Madras, as described by Sir Charles Trevelyan, is as bad as that of Calcutta. The soil upon which the city stands is white sand. The river Kooam, which passes through it, is a tidal estuary, receiving all the town drainage along its course; but as the mouth of the estuary is silted up for most of the year, it becomes a foul stagnant open cesspool, which is washed out once a year by the floods. Sir C. Trevelyan describes the drainage as being "extremely defective." 5303.
There are, he says, plenty of drains, in one sense too many, for 5306.
they are offensive in the extreme, because there are no means of propelling the offensive matter and getting rid of it. The drainage is effected by open drains "of the most offensive and scandalous 5305.
"description." There are no means of flushing them, on account 5309.
of deficiency of water; and such is the offensive state of the general atmosphere from these defects, that a high wall is maintained between the Government House grounds and the body of the town, in one of the most thickly populated portions of the town, expressly for the purpose of excluding the noxious smell that may issue from the drains, thereby excluding the sea breeze, and preventing the improvement of the adjoining part of the town, and thus greatly aggravating the evil.

The water supply for domestic use is likewise "extremely "deficient," and it has become partially deteriorated by offensive matter from the drains. Sir C. Trevelyan states that the introduction of a pure water supply is an extremely popular subject, and extremely desired by the people; and that it is a matter of urgent necessity, on the commonest principles of duty, to provide it. 5315, 5308.
He further states that the health of European troops must be more 5317.
or less affected by those circumstances, and that he had proposed 5310.
that the health of the European population of Madras should be improved (not by building a wall of separation between them and the natives, but) by powerfully acting on the conditions of health of the 5314.
native population itself.

As to Bombay, the evidence contained in the Station Report is of a similar character. The population is between 400,000 and 600,000. The drainage is very defective, the native houses generally in a filthy condition, with much ordure within their precincts, which has been accumulating for years. Nuisance is experienced in the town barracks from the wind blowing over the

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1221.

densely packed houses, and also in Fort George from butchers' shambles and public necessaries about half a mile distant. Cholera follows its usual law of propagation in Bombay as elsewhere. Dr. John McLennan states that those natives living in the lowest, worst ventilated, and dampest part of the island, particularly in such places on the shore, suffer most. He also informs us that cholera and bad fever at one time frequently prevailed in the European crews of vessels undergoing repairs in the dockyard, a close, badly-ventilated situation, not far from the opening of a drain running into the harbour.

Dr. Haines shows that in 1861, the 16,200 deaths* among the population of Bombay were chiefly by zymotic diseases; thus, 1,600 deaths were by small-pox, 1,251 by cholera, and 7,024 by fever.

After calling attention to the insular situation of Bombay, its invigorating sea breeze, excellent water supply, and the abundance of open space for recreation, he goes on to add that when the streets are widened, when the water supply is rendered accessible to all, and when house drainage, and an effective system of sewage have been established, "there is no reason why Bombay should "not rank among the very healthiest of tropical cities."†

Stational Report.

The water supply at Agra is bad, and cholera has been fatal.

Delhi before 1857 was said to be unhealthy. Sir Charles Napier,‡ however, held that it might, perhaps, be made as healthy as any part of India. "In most parts of India," he says, "the effects "of man's imprudence are attributed to climate! If a man gets "drunk, the sun has given him a headache, and so on. Every "garden at Delhi, if not kept clean, becomes a morass; weeds "flourish, filth runs riot, and Delhi is unhealthy. The result is, "that the grandest city in India has the name of being insalubrious, "though it does not appear to have any natural cause to produce "sickness; no natural swamps which would require vast labour, "science, and sums of money to overcome. Nothing evil, in "short, that does not appear to be of man's own creation."

The natural advantages of Bangalore are very considerable; but it has nevertheless afforded a high sick and death rate, and the population, civil and military, have suffered severely from dysentery and cholera. During the period included in the return from this station the barracks were bad, and their "conservancy," in the opinion of Inspector General Macpherson, worse. The natural drainage from the ridge on which the cantonment rests is good; but as it is not properly taken advantage of, the surface filth finds its way into the tank, which, during the dry season, supplies the dense native population with water. "Every obstacle," the Commander-in-Chief Sir Patrick Grant adds, in a note, "has been "thrown in the way of procuring a copious supply of pure whole- "some water, but it is hoped they are now (in 1860) in a fair "way of being overcome."

Report in 2nd Vol. fol. ed.

* 10,559 bodies were buried, 4,736 burnt, and 905 exposed to carrion birds.
† Fourth Report on Deaths in Bombay, by Rob. Haines, M.B., p. x.
‡ Sir Charles Napier, Defects of Indian Gov., p. 271.

Inspector General Macpherson further notices that the native population of Trichinopoly exceeds 100,000; that the streets are clean; but that the "environs of the military cantonments are "resorted to by the natives for the purposes of nature," giving rise "by the excessive accumulation of surface filth, to offensive "odours injurious to the public health."

Evidence of a similar kind might be adduced with regard to all native towns near military stations; but this brief statement of the sanitary defects existing in the seats of government of the three presidencies and at two or three of the more important stations is quite sufficient for the purpose we have in view.

It is satisfactory at the same time to be able to state that Bombay has recently been provided with an excellent water supply, and that extensive works of drainage have been undertaken at Calcutta.

In all native towns there is some system of cleansing and removing nuisances in existence; but this, though indispensable as far as it goes, constitutes only a small part of the sanitary improvement required. There can be no doubt that well-considered measures of water supply, drainage, paving, cleansing, and general construction in these towns would be attended with most beneficial results to the health of troops quartered near them. And as regards the native population, we concur in opinion with Sir C. Trevelyan, who says, "I consider that not "only the preservation of life and health is concerned, but the "strength and comfort and general efficiency of the population "are involved; they would be better and abler men, women, "and children for all the purposes of life, if the average standard "of mental and bodily vigour were improved by the removal of "these local causes of a low state of health." 5307.

Every military station in India has its bazaars, mostly in close proximity to the European lines. They consist of huts or houses arranged on no general plan, and without any regard at all to sanitary conditions. They have grown up anyhow, and have increased with the bazaar population, which always bears a very high proportion to that of the European troops at the station; *e.g.*, Bangalore, already referred to, has accommodation for about 1,700 European and 2,600 native troops. The native population within the cantonment is 124,000, three-fourths of whom live in the bazaar close to the European infantry barrack. There has hitherto been no limit to the proximity by which these large native populations may approach European barracks, nor to their position as regards prevailing winds. There are no regulations as to the general arrangement of the houses, the width or direction of streets, drainage, or water supply. The habits of the natives are such that, unless they are closely watched, they cover the whole neighbouring surface with filth; and if there be any ravines or pits in the neighbourhood they convert them into dangerous nuisances. There are generally no public necessaries. There are often open cesspits among the houses. The surface drainage sometimes flows into tanks, from which the water supply is derived. Stational Reports, *passim*.

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Surface cleansing and removal of nuisances are enforced with more or less efficiency by the bazaar magistrates, but, in the absence of both paving and efficient drainage, it is impossible to effect either object satisfactorily.

52–3. Sir R. Martin describes the cleansing and drainage of bazaars as quite deficient, and recommends systematic medical police arrangements for the purpose.

645. Deputy Inspector-General Stuart states that the natives generally retire to neighbouring ravines, where these exist, and that there used to be, generally speaking, no proper police to maintain cleanliness.

3906. Sir Proby Cautley gives the following account of the bazaars at Cawnpore:—

"To give the Commissioners an idea of the state of these bazaars, I may mention that the natives build their huts entirely of mud dug out of holes as near as possible to the place where they build. In the Cawnpore bazaar I came upon ponds full of black mud and all sorts of filth, and the whole place was utterly unventilated, which was a very remarkable illustration of how ill-health was produced, not only in the immediate neighbourhood, but all round the place."

3907–8–9. He states that the practice of pond-making, as a receptacle for refuse matter, is common to every town bazaar in India. They dig the mud for the huts close by, and do not fill in the hole again. This hole serves to receive all the filth of the town, where it remains exposed to the sun. As a bazaar becomes more populated it becomess less ventilated, and in time a very serious nuisance.

The Reports from the Stations confirm these general statements given in evidence, and show that in time past bazaars have been neither more nor less than native towns of the worst class, which have grown up in and around military cantonments, without any suspicion having been apparently excited, in the first instance, as to their probable influence on the health of the troops.

3132. The bazaar police is more efficient in some stations than in others, so that all bazaars do not present the same defects; and the regulations are considered to be very good as far as they go, provided they are efficiently carried out.

The evidence on the structure and arrangement of stations shows that there is a considerable difference among them in these matters. The older stations are all more or less defective in many most important points. Sir R. Martin describes the arrangements of barracks and hospitals, with which he is conversant, as very deficient. He says that there has been a great neglect of the means of cleansing, and that the drainage is almost universally insufficient for the purposes of health.

13, 19.

In many of the older stations the buildings are so placed towards each other that the free external movement of the air, a condition essential to health in India, is obstructed so as to render the air positively stagnant. Sometimes high walls surround the buildings so closely as to produce the same result.

This class of defects, though existing more or less in most European stations, is most common in native lines, where the huts are often placed as close together as they can stand.

Sanitary Condition, &c.

In new stations, such as those in the Punjab, at Umballa and Poona, there is more regularity of structure, and the different barrack buildings are sometimes arranged *en échelon* to catch the prevailing winds.

But the older stations are very irregular, as *e. g.*, the barracks at Madras, which consist of closed squares of buildings, at Cawnpore, Dinapore, &c., where the buildings are arranged so as to make good ventilation impossible. 1065.

In fortified stations the barracks are often very much crowded together, and some of them are in bomb-proofs, hardly fit for human habitation in such a climate.

Drainage of Stations.

Drainage of Stations.

All the stations are surface-drained with more or less efficiency, but with very few exceptions this is the only form of drainage which exists at any Indian station. The surface drains are either mere cuts in the ground, or they are formed with brick or some other material; and are led to an outlet, generally a cesspit, a ditch, or a ravine or nullah, where such exists. But very often the water is conveyed only to a certain distance from the barrack, and left to provide an escape for itself. The whole procedure is that usually adopted for camps, and is wholly unsuitable for permanent stations. Colonel Greathed states, as the result of his experience, that when there is a heavy fall of rain, it is very commonly not carried off as well as it might be. Even this surface drainage is executed on no general plan. Sir Proby Cautley states that one reason of the defective condition of the surface drainage is that the drainage of cantonments is generally done in detached bits, instead of being carried out comprehensively. He states that the want of drainage has been a general defect, but that latterly great improvements have been effected; that he attaches great importance to a proper system, and that, were it carried out, he is of opinion that such places as Cawnpore, Delhi, Kurnal, would be comparatively free of disease. The annual mortality at Cawnpore has been as high as 91 in 1,000, chiefly from fever, dysentery, diarrhœa, and cholera; which Sir Proby Cautley states, has been due to the condition of the station, the want of drainage, and the filth in the bazaar. And on being asked whether he considers Cawnpore a fair illustration of the general defects of drainage in India, he replies, "A very good "illustration," admitting at the same time that it is perhaps an extreme one. Sir John Lawrence considers that drainage has not been cared for so much as it ought, although it has been improved considerably of late years. The flushing of the surface drains is generally left to periodical rains, or they are swept out by the native establishment.

Stational Reports. 1698. 3105. 3905. 3912–17. 3928. 2922. 1697.

The abstract of stational reports gives information as to the condition of the drainage at most of the stations.

So far as we can learn from these reports, there appears to be no method of conveying away the roof water from buildings, which consequently sinks into the ground where it falls, and

Drainage of Stations.

accumulates moisture close to the foundations of both barracks and hospitals. There is no such thing as subsoil drainage carried out at any station. The rain-fall no doubt partially runs away by the surface drains; but the great bulk of it, amounting to many feet in depth during each rainy season, goes to saturate the subsoil with water. The conclusion of the rainy season is generally attended with a great increase in epidemic diseases. And, inasmuch as wet or damp subsoils are well ascertained causes of this class of maladies, even in cold climates, in such a climate as India the neglect of subsoil drainage within the area of stations is doubtless one great cause of increased sickness and mortality. Indeed the effect of undrained subsoil on health is well known in low-lying stations throughout India.

3426–30. The floors of barracks and hospitals are often damp from this cause. Dr. James Bird cites, as an illustration, the case of Colaba, which was not sufficiently drained; the barracks were extremely unhealthy, and about 85 per cent. of the sickness arose from fevers. The floors rested on the ground, and water could be found within three feet of the surface. Such sites, he continues, produce a large amount of sickness, and a large amount of mortality generally.

1672. Major-General Goodwyn mentions the case of Berhampore, in which the barrack square was pretty well drained; but the marshy state of native lines and of the parade ground, was a cause of unhealthiness.

5840. In regard to Berhampore also, Dr. George Wallich says, "There "is one part of it so unhealthy that Europeans will not live in it. "One house has the name of 'Fever Hall;' and as certainly as "any one goes to live in it, he takes fever."

1032. The reason assigned for the absence of any but surface drainage is the want of sufficient fall at many stations; but if there be not fall enough to enable the subsoil to free itself of moisture, the ground is certainly unfit for occupation by troops, unless the water were pumped up and removed by machinery. All stations are not equally deficient in this respect; there must be many with fall enough for every purpose towards an available outlet.

Stational Reports.

There is, of course, no drainage for conveying away any of the fluid refuse of stations. In the majority of instances, this either passes off by the surface drains, or it is run into shallow cesspits, from which it is removed by hand, and carried or carted away. Sometimes the fluid refuse is passed into deep cesspits, at no great distance from the barracks, with the view of its draining into the subsoil; the water from the subsoil being, at the same time, the source which supplies the wells.

Neither latrines nor urinals are drained. For all the purposes to which drainage is applied in this country, as a means of preserving health, it is unknown in India. Our cities and towns, as well as our home stations, have been or are being drained, because the absence of drainage is well known to be fatal to health; while in the hot moist climate of India, no effectual step has been taken as yet to introduce this indispensable sanitary improvement.

Drainage of Stations.

The present surface drainage is altogether insufficient for conveying away fluid refuse. The drains are very liable to fall out of level, and to accumulate foul water at points dangerous to health. Were they ever so perfect in construction, they could only remove that part of the rain-fall which happened to flow into the surface drain along its line; but this would leave the subsoil charged with water and organic matter washed into the surface, the tendency of which is to render the ground more unhealthy (by the generation of malaria) than it would otherwise be, and, in course of time, to make it uninhabitable.

The evidence given before us, as well as the stational reports, when carefully considered, all go to prove that the drainage of Indian stations on a well-digested plan to suit local circumstances, is a work of urgent necessity for improving the health of the army.

Irrigation.

Irrigation.

Considerable discussion has arisen as to the effect on health produced by works of irrigation carried on in the vicinity of stations. To increase the productiveness of dry soils the waters of rivers are conducted over certain parts of the country in canals, large enough for inland navigation, and the supply is let to cultivators, who are permitted to draw and apply it in their own way. In some places water for irrigation is collected in reservoirs. The land itself being undrained, can only take a certain definite quantity of water without producing malaria; but the natives give little consideration to this, and they flood the surface. The influence on health of this method of irrigation has varied in different districts of India. In the Madras Presidency, both Major-General Cotton and Deputy Inspector-General Maclean, state that no injury to health has been observed even among Europeans. In the Bengal Presidency, careless application of water is attended by prevalence of periodic fevers and spleen disease, which has led to the prohibition of irrigation within a considerable distance of military stations,—five miles, as regards rice cultivation. A committee was appointed to examine into the alleged unhealthiness of the process. They found that whenever the soil was of very tenacious character, and too much water used and allowed to stagnate, disease showed itself. There is no evidence in any of the Stational Reports of the production of fever by land under irrigation; and so far as concerns the native population, the advantages of a water supply for agricultural purposes are so very great and so intimately connected with their well-being, that the question which arises is, not whether the irrigation should be discontinued, but how it can be continued without injury to health.

2044, 2320.

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3967–3992.

In Southern India it appears to produce less injury than in Northern India, but wherever water for irrigation is applied in any quantity, subsoil drainage is indispensable both for health and productiveness, and ought always to accompany works of irrigation.

Water-supply.

Water-supply.

The water-supply of stations, as well as of towns, is derived from three sources,—tanks, wells, and rivers.

In low flat districts, and in deltas, tanks are chiefly relied on. The supply at up-country stations is mainly derived from wells of from 20 to 30 feet, or more, in depth.

Stational Reports.

River-water is used where a river happens to be the most abundant and accessible source. The universal method of distributing the water is as follows:—It is drawn from the tank or well by dipping skins or other convenient vessels, and it is carried by water carriers (bheesties) from its source to the barrack, and there emptied into such receptacles connected with cook-houses, ablution rooms, &c. as may have been provided for its reception.

At some of the larger stations the water is conveyed by bullocks. For drinking purposes an ordinary wooden barrel or a jar is provided; the water is poured from the water skin into it, and the water is drawn from the barrel by dipping.

It will be seen that the entire method of supply for permanent stations is the same as that usually adopted for armies in the field.

However requisite it may be to adopt it under the pressure of necessity, it is obviously unsafe to trust to such a method of supplying troops with one of the prime necessaries of life at all other times.

Somewhat similar methods have always been in use among uncivilized or imperfectly civilized populations. But in proportion as civilization has advanced, such rude and unsafe expedients have been relinquished; and greater attention is now paid both to the source from which water is derived and to the method by which it is distributed for use, especially in towns.

A considerable amount of useful and valuable evidence has been laid before us on this most important subject by distinguished chemists, two of whom are officers of health in the metropolis, and specially conversant with the whole subject. One of these gentlemen, Dr. R. D. Thomson, who has visited India, describes the
4754, 4796. state of the Indian tanks as "quite shocking." He states that he would certainly not be satisfied if the population of his district (Marylebone) had no better water sources than those at the command of the Indian army, that, indeed, he would consider them
4798. very dangerous, and that he would expect a "very much higher" rate of mortality in the parish if the water-supply were of a similar kind.

Dr. Letheby, Officer of Health to the City of London, gives evidence to the same general effect. He is asked:—

"4671. Supposing in an epidemic country you have superficial wells dug in a soil containing a large quantity of organic matter, and suppose the mode of drawing that water is by throwing buckets into the well, drawing the water up, spilling part of it upon the surface, part of the water being washed into the well again, and suppose that the water so drawn up is carried in skins, and distributed to the consumers, what do you think is likely to be the sanitary result of such a proceeding?—That I could hardly speak to, except from an examination of

WATER-SUPPLY.

the water, but I should say the mode of distribution is very objectionable, and is likely to give the water organic impurities, and to make it, indeed, worse than it originally was. The soaking of the water from the soil back again into the well, and the redistribution of it in skins, must be a means whereby an additional impurity must be given to the water independently of that which was in it before,

"4672. So that in a country where epidemic diseases prevail you would object, in a sanitary point of view, to that mode of distribution?—Yes, I should object to that."

In examining the objections against the present system of water-supply more in detail, it appears that, with very few exceptions, the water from no source in India has been submitted to chemical analysis. In the exceptional cases given in the reports from the stations, the results of analysis, so far as they go, are by no means satisfactory as regards the purity of the supply.

At certain up-country stations, the well water contains a large amount of salts; and a similar excess of saline matter is observed in tanks, rivers, &c., during dry weather. 5717.

There is every reason to believe also that many water sources contain a large amount of organic matters, animal and vegetable; but in scarcely an instance is there any qualitative analysis given. The qualitative analysis of water from the wells and tank at Secunderabad, however, gives results of an extraordinary character. This station (which has suffered so severely from bowel diseases) is supplied with water from six sources, containing from 10 grains up to 38, 44, and in one instance 119 grains of solid matter per gallon; and of this amount it appears that organic matter of some kind or other exists to the extent of from above 2½ grains to 8, 11, and apparently, in one instance, up to 30 grains per gallon. Stational Report.

For all practical purposes, as regards the health of troops, the composition of the various water sources in stations may be said to be either unknown or too imperfectly known to be of any real use.

All we can gather from the evidence and the stational returns, is that some waters are considered good, some tolerably good, and some not so good. *Vide* Miss Nightingale's Observations, p. 298, *post*.

But in the selection of sources, it seems not to have been considered necessary to make any special inquiry on the subject.

In some exceptional cases the water-supply is stated to be peculiarly defective as to its purity, and "some very good wells "become dangerous from disuse." 586. 589.

Again, it is the result of universal experience that shallow wells, such as those used in India, which receive their water from the rainfall draining through a soil highly charged with organic matter, always contain a considerable amount of that matter in solution. In ground at a distance from human dwellings the organic matter will be chiefly of vegetable origin. But wherever there is a population on the surface, with neglect of ordinary sanitary precautions as to surface cleansing, drainage, and especially cesspits or other nuisances, the chances are that the wells will contain a considerable amount of animalized matter. Vegetable impurities in water rarely manifest their presence either by taste 4578. 4589.

WATER-SUPPLY.

or smell. In some most fatal instances the presence of decomposing animal matter in wells has rendered the water containing it apparently more agreeable to the taste.

4582.

4598, 4603. The extent to which these impurities prevail in shallow wells is much greater than the public is at all aware of. Dr. Thomson has given the constituents of 44 wells or street pumps in the parish of St. Marylebone (having a depth of from 12 to 20 ft.) containing from 42 grains to 133 grains of solid impurity per gallon, the organic matter varying from about 5 to 33 grains per gallon. All of these waters are unfit for use. Dr. Letheby says, in regard to these and other similar wells, "there is no "shallow well at all in London which contains pure water." As already stated, the cause of this impurity is to be sought for in the existence of organic matter in the soil.

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4060. An example of this in India is given by Colonel G. Campbell, in which certain wells at Lucknow became contaminated on account of a number of elephants having been buried near them. The recognized impurity of the water in this case led to its disuse.

4582. But generally, as stated by Dr. Letheby, these impure shallow well waters look clear, fresh, and rather inviting, because of the presence of carbonic acid, which gives them a sparkling quality, and because of their temperature and their slightly saline taste caused by the presence of nitrates produced during the process of decomposition of animal matter.

3435. Dr. James Bird states that the waters of Bombay, drawn from wells, contain a considerable amount of organic matter.

The water of open tanks is exposed to similar sources of impurity. They are dug in soils which have been for ages covered by a rich vegetation. They receive the drainage of the whole of the surrounding area, and during heavy falls of rain, whatever impurities there may be on the surface are washed into the tank, which is in fact the drainage outlet.

Some of the tanks are lined with stone, others are banked with more or less care, and kept free of vegetation. Some of them resemble ordinary horse-ponds; in some instances covered with a minute vegetation which, it is considered, rather improves the quality of the water, by assimilating its dead organic matter. It is the custom to set apart tanks for bathing and washing, and tanks for supplying water for domestic use, cooking and drinking. There is a tacit understanding that tanks of the latter class shall not be used for the former purposes, and sometimes they are guarded. Notwithstanding these precautions, the evidence shows that a large amount of organic matter finds its way into them.

The tanks used by Europeans are generally safer in this respect than those used by natives, but still their purity depends to a very great extent on the state of the surrounding surface, and the

5856. water is all more or less stagnant. Sometimes the same

2763. tanks are used by European and native troops. The use of stagnant water has by itself been known to occasion ague; but besides this the Indian tanks are, many of them, exposed to

pollution from filth, on account of the dirty habits of the natives, described in the evidence of Dr. G. C. Wallich, as follows:—

"5855. Independently of that, the habits of the natives, who defecate all over the surface of the country, must necessarily cause the water in the tanks to become impure?—Yes, it is so; in point of fact the natives have no idea of taking sanitary precautions. For instance, a man will eat and drink and perform his evacuations actually on the very same foot of water, standing in it, or close to it; he has no idea of impurity as long as it happens to be Ganges water.

"5856. The European troops and also the native troops drink the water from these tanks?—Yes; there is nothing else for them, and the same causes will operate with Europeans in an increased degree."

After describing the same native habits, Dr. Mouat states that a heavy shower of rain washes down all soluble matter, through the natural percolation of the soil, and it must find its way into the tanks. 5788.

Speaking of the tanks used by the natives, Dr. Falconer says, that the purity of the water in them will depend upon the washing in of the surface, and upon the nature of that surface. If decayed vegetable matter or animal excreta were thrown out on the surface, and the rain drainage took that direction, the water in the tank would become tainted and unwholesome. 5402.

Taking into consideration the habits of the natives, and the general state of the surface near stations and towns, it must be evident that considerable danger to health must arise from the use of tank water.

Such a source of supply is not made use of for any military station at home, or indeed for any domestic purpose. Such water, even in this climate, is considered bad and dangerous, and in such a climate as that of India it is more so than at home.

We next come to consider the probable effect of this condition of the water-supply upon the health of the troops; and in doing so we shall have to be guided to a large extent by the experience obtained in sanitary inquiries at home. Dr. Letheby says on this subject:— 4564.

"I think I may say that not only myself but all the officers of health of the metropolis are of opinion that bad water is a frequent cause of disease.

"4565. And that it aggravates some of the diseases?—Yes, there is no doubt of that.

"4566. Do you mean that impure water itself produces disease, or merely that it predisposes to disease?—It does both. I believe, in the first place, when there is a natural tendency to disease, the condition into which the water will bring the alimentary canal will tend to establish that disease, or set it on foot; and that decomposing organic matter, in certain conditions of decay, in the alimentary canal is sufficient, without any other agency whatever, to cause disease.

"4567. So that next to impure air you would rank it as one of the most powerful causes of disease?—I am disposed to think it is before impure air, as being one of the most powerful causes of disease."

This evidence gives the experience up to the present time.

During all great epidemics popular opinion has pointed out the state of the water as one of the chief causes of pestilence, and modern experience has confirmed this by minute statistical inquiry.

WATER-SUPPLY.

The diseases to which bad water peculiarly predisposes are mainly epidemic diseases, affecting the intestinal canal, such as cholera, diarrhœa, and dysentery.

4673. To the use of impure water have also been traced fevers of the intermittent type.

The evidence on these points is conclusive, and extends not only to well water but also to impure river water. During the cholera epidemic of 1848–9 several instances occurred in which nearly every person using water from particular wells was affected with diarrhœa or cholera, and of the cholera cases nearly all died.*

4598. During the epidemic of 1854, of 73 persons who died of cholera in a certain street in the metropolis, 61 had drunk water from a pump polluted by sewage, while the people who did not use the

4774. water were not so severely visited. A vessel of this water was sent to a lady at Hampstead, and she was attacked and died of

4771. cholera. The water, on being analysed, was found to contain 92 grains of solid matter in the gallon, of which 7·8 grains were organic matter. During the same epidemic the population of Southwark and Lambeth suffered severely from cholera, which was attributed to the state of the water-supply. The affected district was supplied by two companies, one of which gave a comparatively pure water, and the other a very impure one, containing sewage matter from the Thames. The deaths from

4787. cholera in the houses supplied by the purer water were in the ratio of 37 in 10,000, while the ratio among those supplied with the impure water was 130 in 10,000. This special case was the subject of elaborate statistical inquiries made by the Registrar-General's department. Referring to these facts, Dr. Thomson says:—"Therefore I conclude that there were destroyed by the "Southwark and Vauxhall Company (whose water at the time "was impure) 2,500 persons."

4569. In the same manner as the mortality from cholera has been diminished by the use of pure water has the mortality from dysentery also diminished.

In applying this experience to India it is necessary to point out that the diseases which our home experience has proved to be so strikingly under the influence of the quality of the water are the same diseases which bring so much loss and inefficiency in the Indian army. This fact would of itself lead to a strong suspicion that the water is impure. But it must also be borne in mind that the troops drink a large quantity of water, especially during the hot season, and that bowel diseases are generally most prevalent and fatal in the hot dry weather when the water supply is diminishing and becoming daily more impure from evaporation and want of rain. Sir John Lawrence, in his evidence, states:—

3013 "In India one great point upon which good health depends is the water; our people very seldom look to the water, but the natives always look to the water in choosing a locality.

"3014. I believe that the troops drink an immense quantity of water mixed or unmixed?—Yes.

* Report on Cholera, General Board of Health.

"3015. Therefore it is important that the water should be of good quality?—Yes; I think that there is very great scope for improvement in the selection of sites in that way.

"3016. In England we find that the water has a great deal to do with the mortality in cholera?—Yes; I have seen positions which were considered unexceptionably good by Englishmen, but if you asked the natives about one of them they would say that it was very bad on account of the bad quality of the water."

In a district where there is a strong predisposition to bowel diseases, whenever even the inorganic saline impurities in the water exceed a certain amount, there is danger to health. The production of diarrhœa by such waters even in Europe is perfectly well known, especially at certain seasons; and the same fact has been observed in India. Dr. Mouat has no doubt that in a marshy district, impure water has a tendency to produce diarrhœa, especially when, in a very dry season, the wells, and even the tank water, are more or less loaded with salts; diarrhœa is very rife in those cases, and the same thing occurs from water that is drunk from tidal rivers; for even in the hot season, when the tides are very low, the water is to a certain extent brackish. He states that he accompanied a detachment of sailors to Assam during the mutiny, and the water was all taken in alongside from the river: a most frightful outbreak of cholera occurred within 24 hours after embarkation, and the men traced it to the water distinctly. 5717, 5718.

Dr. Wallich states that there is a great quantity of impurities in tanks, that the water is "completely" "charged with organic "matter" and that the animal organic matter (in the tanks) is certainly a cause of fevers, dysentery, and cholera. But we cannot ascertain that there has been any attempt to estimate the nature and amount of the impurities, or their probable influence upon the health of the army. 5838, 5840, 5842, 5843.

It is known that water from marshy districts in this country contains from four to five grains per gallon of vegetable matter, and that it would be considered injurious to health to use such water. 4581.

As regards putrescent animalized matter, Dr. Thomson states that he would consider the presence of "any quantity objection-"able" in a country like India, where bowel disease prevails. 4849.

Dr. Angus Smith states that, while three grains of peaty matter could hardly be considered bad in a sanitary point of view, half a grain of putrefying matter "might be intolerable," and that water containing from five to six or ten grains of organic matter per gallon could not, he believes, be drunk, and could not be used at all. 2753–4.

The rude and imperfect method of distribution in use has already been adverted to as an additional source of impurity, which would not be submitted to at any home station.

Dr. Sutherland, in reviewing the whole question in its reference to barracks, says, "We should certainly recommend for our home "stations the abolition of the entire mode of supply of water "mostly used at the Indian stations, both as regards the source "and the mode of collection and distribution." "There has," he 5490.

WATER-SUPPLY.

says, "been no application apparently of any modern improvement, "as regards either the examination of water sources or the means "of collecting or distributing water for use for stations, bazaars, "or towns." He says that "the present condition of the water-"supply is one of the cardinal defects in the sanitary arrangements "of India, and that it is unquestionably a predisposing cause of "disease, especially during the prevailing seasons of cholera, fever, "dysentery, and other zymotic diseases."

The evidence before us goes to show the necessity of making a very careful chemical investigation of all the existing water sources at the stations, with the view of improving them, either by adoption of precautionary measures for diminishing the risk of pollution, or by selecting a purer supply. Any water sources which are found to be irremediably impure should be at once rejected. The purest water is that which is obtained from primary rocks, such as granite, mica slate, and clay slate, or such as is obtained from pastoral districts. Next in order of purity, but by no means so pure, is the water from agricultural districts, represented by rivers.

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Deep wells afford good water, if care be taken to protect them from surface impurities, whether percolating through the soil or finding an entrance by the well's mouth. The water of shallow wells, as already stated, ought always to be avoided.

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It is highly probable that a careful chemical inquiry would prove the majority of tank waters unfit for use.

In conducting these inquiries, the same method should be adopted as is followed in this country in supplying towns with water. The degree of hardness, by Clark's test, should be ascertained; next, the quantities of organic and inorganic constituents per gallon, their precise nature, and the amount of each.

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As illustrations of the beneficial results of this method of procedure, it may be stated, that the impure water sources of the metropolis were abandoned and better water provided, with marked improvement in the health of the population; that a proposal to supply the city of Glasgow with well water was rejected after chemical analysis, and at a great expense the people obtained a supply, the total impurities in which amount to 2·35 grains per gallon, of which only 0·605 grains consist of organic matter. If the chemical constitution of this water be compared with that of the supply of Secunderabad, already mentioned, a clear idea will be obtained of the great importance of chemical inquiry on such subjects.

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It may be useful to state briefly the nature of the improved water sources, together with the methods of distribution which have been adopted of late years in this country. The purest waters are those derived from mountain springs or streams, collected and stored either in large artificial reservoirs in upland valleys, such for example, as those for Manchester and Liverpool, or in natural mountain lakes, such as Loch Katrine, from which Glasgow derives its water. We have already noticed the small amount of impurity in the Glasgow water. Manchester water obtained from a hilly district contains 3·33 grains of impurity per

WATER-SUPPLY.

gallon, of which ·680 grains is organic, chiefly peat. It is found highly advantageous in these cases to bring the water a distance of 30 or 40 miles in iron pipes; and as the reservoirs are at a considerable elevation, the water is discharged by head pressure, and can be delivered by gravitation all over the towns for which it is intended. This though in the first instance a costly method, is the best and cheapest in the end, because it ensures a constant supply of pure water, and delivers it without the cost of machinery.

In many parts of the country such advantages cannot be obtained; and in these cases wells are dug to a great depth, until water-bearing strata are reached affording water of sufficient purity. Engine power is provided to raise the water into iron tanks elevated to a sufficient height above the ground to enable the town to be supplied by gravitation from the tank.

In other instances, such as the metropolis, water is derived from rivers, and distributed in a similar manner; but its purity cannot be so much depended upon. But even the metropolitan waters are pure when compared with those Indian waters, of which we have an analysis. The total impurities in waters supplied by the Thames companies may be taken at about 20 grains per gallon, of which from 1·24 to 1·76 grains consist of organic matter. Water supplied by other London companies contains a little more impurity.

As regards analysis, it is considered necessary not only to ascertain the comparative purity of a water source at the time of its selection, but periodical analyses are made from time to time, to see that no casual impurity has obtained admission.

In all the improved supplies the water is delivered from pipes to the consumers; a method of distribution which experience has shown to be absolutely necessary for health and cleanliness.

Purity, abundance, and facility of use are the three principles which require to be kept in view; and they are, if possible, of far more importance in India than at home.

It may not always be possible at the Indian stations to obtain purer sources of supply; but there can be always at hand the means of reducing the impurities to a minimum; filtration can be adopted everywhere, on any required scale, and the water obtained free of suspended impurities.

Of late years scientific methods have been applied even to the removal of organic matter held in solution by the water. A filter composed of bone-charcoal, with peroxide of iron, is found to oxidise organic impurities, so that the water passes through without any perceptible remainder. 4622-9.

It might possibly be practicable to obtain water for certain stations by having collecting reservoirs in hilly districts from which water might be laid on after careful filtration.

Whatever be the source, the water should be laid on to every barrack and hospital directly by gravitation, or, if local circumstances prevent this from being done, the water should be raised by mechanical power, and stored in tanks at a sufficient elevation to enable it to be distributed by gravitation. Any way the present

Water-supply.

method of drawing and distributing by hand labour should be discontinued for all fixed stations, with the least possible delay. As the rain-fall in India is irregularly distributed over the year, special arrangements are required for collecting and storing it up in the rainy season, or for recovering it from the earth and purifying it.

An abundant supply of pure cool water for drinking purposes is an essential requisite for all barracks. Nothing hitherto has been done in this direction; and we strongly recommend that drinking fountains be provided at all necessary points, both in the barracks and over the stations generally.

Construction of Barracks.

Barrack Construction.

With few exceptions, the barracks in India are constructed on one general model, varying in detail, especially in the dimensions of the rooms and in the number of men they are intended to accommodate. As already stated, in some of the older forts the barracks are casemated, or built in more than one floor; but in the other stations, the model is that of a hut with doors on opposite sides, which are protected by verandahs. In the more recent barracks, the detail has been varied by carrying the centre of the hut to some height above the sides, like a gothic church; the elevated part being supported on arches dividing the room into a centre and two side aisles, with verandahs outside. The beds are generally arranged along the side walls, two and two between the doors. In the simpler form of construction there are two rows of beds in the room; but where the room has aisles there are four or even six rows of beds between the opposite doors, the inner rows of beds being placed with their heads to the piers of the arches.

Stational Reports.

In the most recently constructed barrack in India, the Dalhousie barrack, at Fort William, there are six rows of beds between the opposite doors. The dimensions of barrack rooms vary very much. Among the smallest rooms are those at the new station of Mean Meer, 48 feet long by 24 feet wide and 24 feet high; they are intended for 16 men each, and to give 1,703 cubic feet, and 72 superficial feet per man. The temporary barrack rooms at Hazareebaugh, built on the standard plan, are intended for 100 men each, at 1,080 cubic feet and 63 superficial feet per man; these rooms are 300 feet long, 20 feet wide, and 18 feet high.

The Secunderabad barrack rooms vary in length from 124 feet to 274 feet; they are from 18 to 24 feet in width, and from 16 to 25 feet high; they accommodate from 20 to 104 men per room, giving about 1,000 cubic feet per man, and from 40 to 56 superficial feet. There is a barrack room at Trichinopoly no less than 1,011 feet long by 18 feet wide and 17 feet high. At Allahabad the rooms are 335 feet long by 22 feet wide and 16 feet high, holding 100 men per room. The barrack rooms at Dumdum, intended for from 30 to 38 men, are about 105 feet long by 22 feet wide and 14 feet high; giving about 1,000 cubic feet, and 70 superficial feet per man.

Barrack Construction.

Probably the longest rooms in existence are those in Fort St. George barracks, at Madras; the lower room is 1,483 feet long by 18 feet wide and 15 feet 6 inches high, and holds 400 men; the upper room is 2,124 feet long by 20 feet wide and 14½ feet high, and is intended for above 600 men; the space per man is 1,000 cubic feet, and the superficial area from 64 to 69 feet. The Dalhousie barracks (already alluded to) at Fort William, contain what is virtually one room on each floor, although it is divided by piers and arches into three breadths, exclusive of verandahs: the length of each room is 287 feet 4 inches, the width 64 feet 5 inches, and the height 19 feet; each room holds 306 men at from 1,500 to 1,600 cubic feet, and from 79 to 85 superficial feet per man.

Nothing can be simpler than the hut with its four walls, roof, and verandahs, which is the model on which most of the Indian barracks are constructed; but in the majority of cases it has been so used as not only to lose its advantages, but to become an unhealthy model of a barrack. An essential condition of every barrack room is that the air in it should be as pure during the night as the air outside; but it is impossible to ensure this if the rooms are above a certain size, and contain above a certain number of men. The healthiest of all sleeping rooms are those which, like the huts of the native troops, contain one or two people, simply because they are so easily ventilated. Whenever the number of inmates exceeds 20 or 30 per room it is practically far more difficult to ensure fresh air, and beyond that number it soon becomes impossible. Sad experience has proved that long rooms, like passages, with 100 or more persons sleeping in them, may become highly dangerous during epidemics, and absolutely pestilential if occupied by sick. The reason of course is that the direction which the foul air may take in the room depends on accidental circumstances, not under control, which may lead to its being accumulated at one end of the room, or over one group of beds. This danger may be incurred at any time with long rooms, even if there be no more than two rows of beds; but when other two rows are added, or, as in the case of the Dalhousie barracks, other four rows, a form of construction is introduced only to be kept healthy by the exercise of greater care than is ever likely to be bestowed on the subject, and by very large sacrifice of space per bed.

Defective as the barracks at home stations have been shown to be in some important points, they certainly possess one great advantage over those in India. The rooms rarely hold more than 10, 15, or 20 men. The windows (at least, in the infantry barracks) are generally on opposite sides; but where there are two rooms in the depth of the building, with openings through the partition walls, such barrack rooms are by no means so healthy, although they may have a thorough draught, simply because the construction enables four rows of beds to be placed between the opposite sides of the building. If an error in construction such as this, even with a small number of inmates, exercises an appreciable influence on health in this climate, it must, of course, be far more prejudicial

BARRACK CONSTRUCTION.

in India, especially in rooms containing from a quarter to half a regiment.

The influence exerted on the health of troops by the large size and construction of barrack rooms in India has not passed unobserved. There is a general impression that great constructive improvements are required.

5645. Sir A. Tulloch states, as the result of his experience, that a very great advantage is likely to be obtained by having separate buildings each for a limited number of men, instead of their all being in one barrack; that they would be much more likely to be healthy in small buildings holding 10 men each; that there would be less risk of disturbance and of the spread of disease.

2906–8. Sir John Lawrence, while stating the great improvement recently made in barrack building, says that the only defect he ever saw is, that the barracks are too large, and contain too many men; that, instead of building a barrack for a whole company, it would be better to build it for a half or a quarter of a company. He considers the smaller barracks much safer in the event of an epidemic appearing, and that small barracks are better for the men, both morally and socially.

2380. Deputy Inspector-General Maclean gives the following testimony on this point:—

> Are you generally in favour of isolation, and of putting the soldiers in separate dwellings, or in smaller barracks?—I am of opinion that they ought to be all in separate buildings. I think that the system which now prevails in India of erecting costly palaces for troops is one of the most unfortunate mistakes that was ever made, because in the first place, the barracks are so costly that the Government grudges the space required for the men; and I am quite sure that if such barracks were built as Colonel Durand knows were erected at Moulmein, detached bungalows, well raised from the ground, and well ventilated with roof ventilation, the health of the troops would be enormously increased, and the Government would save an immense sum of money.

2385–6. He further states that the natives in India never live together in large dwellings; that epidemic diseases are very apt to run through large barracks; and that in barracks of two floors, the lower floor cannot be ventilated.

5490. Dr. Sutherland (who is a member of the Commission for improving Barracks and Hospitals), states that it is impossible to ventilate efficiently rooms with 100 or more men; and that quarter-company barracks, *i.e.*, separate houses for 20 or 25 men, are about the limit to which we should go in this mode of construction in India.

Many of the newer barracks have double verandahs, a construction which has the twofold disadvantage of rendering the ventilation more difficult, and of enabling the inner verandah to be appropriated as extra sleeping space. The double verandah is at the same time an unnecessary cost.

One very important point as bearing on the healthiness of barrack construction, is the relative position of the beds with reference to openings through which the outer air comes in. In the ventilation of home barracks, it has been found necessary for the men's health and comfort that the air shall be insensibly

diffused through the room without draughts upon the beds. In India, of course, a much freer ventilation can be borne than in colder climates. But the difference between the day and night temperature is often so great that an air-current which might be borne with impunity through the day, becomes at night a serious inconvenience, and may be a dangerous cause of disease. As already stated, in the Indian barracks the beds are placed between the doors, or, if in more than two rows, down the middle of the room; but the space between the doors is so narrow that the wind falls directly upon the side of the bed if the doors are open, and if the doors are shut the ventilation of course is shut out too. Deputy Inspector-General Stewart states, that the space between 681.
the doors is generally seven feet, occupied by two beds, each three feet wide, and leaving only one foot between the beds, which, in India, is over-crowding; that the beds project more or less beyond the protection of the wall; that the men occupying them are liable to be injuriously exposed by night and day, and in all seasons, to strong direct currents of air; that in the rains and in the cold season, as well as in the hot months, this exposure may lead to serious results, and that it need not be matter of surprise that rheumatism, pulmonic affections, dysentery, and other serious and fatal diseases should prevail.

It must be obvious that barracks so constructed can never be healthy, and that the ventilation, to be efficient, must be independent of doors and windows, at least during the night.

One cardinal error in barrack construction which prevails throughout India, is placing the barrack rooms at or near the level of the ground. As already stated, the surface of the country is charged with malaria, the action of which extends to a greater or less height above the ground.

Night fogs, which may be considered as indicating the presence 4400.
of malaria, rise to a certain height above the ground, especially in Lower Bengal.

Mr. Montgomery Martin attributes various native diseases partly 4402.
to this cause. He says, further, that troops should sleep above the 4403.
level of the fog; that all the lower stories of barracks or hospitals which he has examined in tropical regions are unhealthy; a result which is caused by a pestiferous gas rising from the earth in regions where vegetation and moisture exist in excess; but that this gas does not rise to any great height, and slowly commingles with the atmosphere.

Mr. Julius Jeffreys corroborates this opinion. He says, that 2803.
in India all kinds of exhalations are rendered visible by smoke or fog in cool mornings; that it is well known that the density of malaria is in some very high ratio inversely proportionate to the distance from the surface of the ground; that he never saw troops in India quartered above the ground; and that the evidence to his mind was quite conclusive that much disease arose from troops being housed on the ground level.

Deputy Inspector-General Longmore instances the occurrence 2181
of these fogs at the very unhealthy station of Dinapore. The

BARRACK CONSTRUCTION.

barracks are very little raised above the ground. He says that in the morning or after sunset, if there is not much air stirring, a dense vapour may be seen resting over the surface of the ground, while above this vapour or a little below it the air is clear. He
2182–3. states that, in his opinion, this vapour carries malaria with it, and that much of the disease at Dinapore might have been prevented by having a free circulation of air below the rooms.

The barracks, he says, are otherwise badly arranged in close squares.

1743. Major-General Goodwyn states, that he knows only of one instance (at Calcutta) in which the barracks are raised above the ground; and that he considers the absence of arcaded basements
1781. as a great fault; he thinks they should be raised at least 12 feet from the ground.

Raising the floors with free passage of air underneath, is necessary not only to avoid malaria but to avoid damp in flat or low-lying districts, where there are small natural facilities for drainage. The stational returns show that the barracks throughout India have been constructed without reference to this primary condition of health. While it is a native habit to sleep only on upper floors, in order to avoid malaria, the European soldier, who is a much more susceptible subject, has all along slept at or near the level of the ground.

Vide abstract of Stational Reports.

The usual mode of constructing floors has been to raise a plinth a foot or two in height, to fill up the space with earth or some other material, and to lay the floor upon it. The flooring consists of various materials, generally of stone, composition, tile, or
757. brick, but sometimes of rammed earth, painted over periodically
4033. with a solution of cow-dung. Referring to the condition of barrack floors, Colonel Campbell states, that if they are in good repair and perfectly smooth, they are always dry; but that if the surface of the plaster becomes broken, the floors
3460. absorb wet, and it remains. Dr. James Bird states, that the mud floors are most objectionable, that brick floors are better, but that a wooden floor is the best of all. Washing floors with cow-dung is a native practice, and is used to render the surface more durable and to prevent vermin. Flooring of this description should be forbidden.

The height to which the floors should be raised above the ground will depend on local circumstances. In low, flat, and damp districts, each barrack should consist of two floors, the upper one only to be used as a sleeping room, and the lower floor to be a covered place for exercise and amusement, as
1780. suggested by General Goodwyn. In more high and dry districts, four or five feet would be sufficient to raise the floor; and less would suffice at hill stations. The space should be arched to allow of the freest passage of air. Objections have been made to this construction, that filth or dead animals get into the space and create nuisance. But this can be easily prevented.

The best kind of flooring for India is, undoubtedly, that which absorbs the least moisture in cleansing. In this climate a good

wooden floor is most wholesome, and there are a number of testimonies in its favour as being the best for India. BARRACK CONSTRUCTION.

The materials chiefly used in the construction of both barracks and hospitals, are burnt brick and mortar; in some instances, burnt bricks set in mud. Sun-dried bricks cemented by mortar or mud, are also used. In a few instances, the walls are of stone and lime, or stone set in mud. Timber is sometimes used as a framing, and more recently iron. The roofs are generally of tile, or thatched, and sometimes tiled over the thatch. In some recently constructed barracks, the roofs are arched and terraced. Double walls or double roofs, having air passing up between them to keep down the temperature, have not been introduced in India. Thickness of wall and roof has been chiefly depended upon. The materials are stated to be well adapted to the climate, generally. But General Goodwyn states that the bricks are often of bad quality, and admit of great improvement in manufacture. Stational Reports. 1731, 1733

This is a matter which ought to be considered; for, as he justly observes, there is nothing more destructive to health than an imperfect brick building. Wherever the plaster peels off, the brick absorbs moisture, destroying the permanency of the barrack, injuring the accoutrements, and, above all, the men's health.

One point in the construction of cavalry barracks is much insisted upon by Deputy Inspector-General Stewart, as injurious to ventilation. There are no saddlery rooms belonging to the barracks, and the men carry their saddles saturated with the horse's perspiration into their sleeping room, where they are kept. The practice is both unnecessary and hurtful. Every cavalry barrack should have a dry, well ventilated saddlery room attached. 710–13.

VENTILATION OF BARRACKS.

The means of ventilation chiefly trusted to in Indian barracks, are doors and windows. BARRACK VENTILATION.

There is very little glass used, and the windows, where they exist, are either venetian, or they consist merely of openings, with solid wooden shutters, which, when closed on account of weather, leave barrack and hospital in darkness. In many cases, the doors are also venetianed.

Many of the hut barracks have louvres in the roof for ventilation. And in barracks with a central raised aisle, there are clerestory windows above the arches, or at the ends, together with ventilators in the ridge.

More attention has been lately paid to this important subject, and many of the newer barracks are better ventilated.

But there is sufficient evidence to show that considerable improvement in this respect is still required.

Sir R. Martin informs us that there has been the same want of strict attention to ventilation in India, as hitherto in England. 165.

Colonel Campbell states that the old class of barracks are 4022–6.

BARRACK VENTILATION.

deficient in upper ventilation, that such openings as exist are, generally speaking, not sufficient for the purpose; that there is frequently much closeness during the night and in the morning. The arrangements in the newer barracks he considers better.

1760. Major-General Goodwyn states that the roof ventilation is at present very spare and scanty.

2643. The ventilation, such as it is, is interfered with by the soldiers; a fact which, of itself, would lead us to suspect that the men are exposed to draughts.

3728–9. On this subject Brigadier-General Russell states that the men do not object to ventilation, but that they object to any air coming upon their persons. When this is not attended to, the men get chilled and suffer from diarrhœa. The danger of draughts at

2840. night is perfectly well known to natives, for Dr. Julius Jeffreys states that, in watching a garden at night, the native places a mat to windward of his bed to cut off the immediate current from his body. He says, this is a matter of really prime importance; for it will often just make the difference whether a man escapes or not an attack of rheumatism or intermittent fever.

1171. In some barracks and hospitals of the Bombay Presidency, an attempt was made to introduce fresh air by air channels under the floor, opening by gratings into the rooms. Refuse of various kinds was thrown down the gratings, and these air channels became the channels for foul air. This is a method of ventilation which ought never to be adopted.

907. The requirements of good barrack ventilation, in India, are summed up by Lieutenant-Colonel Gall, as follows:—

The ventilation should not depend on doors and windows; it should not cause a thorough draught, to which the men are exposed; there should be sufficient space between door and door, and window and window, to allow the men not to be exposed to draughts; and there should be room for a table between every two beds.

The stational reports adduce instances of what may be considered as structural defects in ventilating arrangements.

Sometimes, *e.g.*, the rain beats through the ventilators. Or the amount of ventilation which is sufficient in one state of the wind becomes too much or too little in other states. Or during dust storms, the dust is driven in. We allude to these defects, because often on such small matters the whole question of fresh air to a barrack or hospital depends. The two first admit of remedy, but it is questionable whether anything short of closing every crevice would keep out dust during a real dust storm, for the short time during which it lasts.

3704. The following example of an efficient method of ventilation adopted in an unhealthy barrack at Secunderabad, during an alteration in the barrack, and the result on health, is given by Brigadier-General Russell:—

"The opportunity was taken to raise the walls three feet, and to put on what was termed a Bengal roof, by which a current of air was admitted all round, and wire gauze was placed inside and outside the ventilators, beyond the reach of the men. After this was done no serious case of dysentery, the scourge of Secunderabad, occurred among the men quartered in this building, and the

medical officer, who visited it before morning gunfire, found the atmosphere as pure and sweet as in his own bedroom, which he had just left, while it was very offensive in the other portions of the barracks. This dysentery, I therefore conclude, arose more from the construction, overcrowding, and defective ventilation of the barracks than from their site."

Barrack Ventilation.

In a climate such as that of India it is impossible to estimate the amount of fresh air required to keep either a barrack-room or hospital ward in a good sanitary state. In England 1,200 cubic feet in rooms, and about three times that amount in sick wards, per man per hour, are required. At certain seasons every breath of air becomes of importance, and there is no test, except that of freshness, to be relied on as indicating the efficiency or inefficiency of the ventilation. Ridge ventilation, together with a free admission of fresh air under the eaves, on some such principle as that adopted at Secunderabad, affords the best solution of the problem for India.

Space per Man in Barracks.

Barrack Space.

The greater proportion of European troops in India have, according to regulation, upwards of 1,000 cubic feet per man. In a number of stations the average amount exceeds this, and rises to 1,200, 1,400, and in some instances to 1,600 and 1,700 cubic feet. The average at Secunderabad is 1,000. In about 12 stations the space is less, and varies from 480 to 900. The largest amount at any station is at Rangoon, where the average is 2,200 to each European. The regulation amount on home stations is now 600 cubic feet per man, and at first sight the advantage is very much in favour of the Indian stations. A large cubic space, however, does not necessarily imply absence of overcrowding, for two reasons:—

1. The space may be above the head.
2. The beds may be too near to each other.

Both of these unfavourable conditions exist in Indian barracks; *e.g.*, on account of the great height in many of the barracks, the superficial area per bed by no means corresponds with the cubic contents. The average at the majority of stations is between 60 and 70 square feet; in not a few instances it falls below 50. At Secunderabad the men with 1,000 cubic feet have only 40 to 60 square feet. At a few stations the amount is from 70 to 100 square feet, the largest amounts being at Rangoon, where each bed has 120 square feet, and in the bomb proof barracks, Fort William, where the surface area is 140 square feet per bed. But the report states that even with this amount of superficial area, one half the number of men would be too many.

From the construction of the barracks, the beds, as already stated, are too close to each other, every pair having only a foot between them, while at the same time there is a large unoccupied floor surface. Practically, therefore, nearly every barrack-room is overcrowded.

The regulation amount of space by no means represents the degree of crowding which may take place in a barrack. Usually the

BARRACK SPACE.

number of men is the number which may happen to be at the station, be that number more or less; and it has been stated that the lofty barracks recently constructed have been expressly intended to prevent a larger number of men being put into them than the floor surface would accommodate. This is an error. With the intention of preventing overcrowding, it really introduces what in India is the worst form of overcrowding, viz., bringing the beds too close together.

2026. Major-General Cotton advocates a much better course. He says that, in point of fact, it would be well to have the barracks so constructed that, in case of emergency, they might be capable of holding more men than under ordinary circumstances. He advocates lower rooms, and more attention to ventilation.

2352. Deputy Inspector-General Maclean states that overcrowding and bad ventilation have been the master sins of the old system.

5508. As regards the amount of cubic space and superficial area required for health, Dr. Sutherland states that this will depend on the position of the barrack, that on high ground, with a free circulation of air, 1,000 cubic feet and 80 square feet per man are enough; but that in low, imperfectly ventilated positions it would be necessary to raise the amoumt to 1,500 cubic feet and 100 square feet per man.

MEANS OF COOLING AIR IN BARRACK ROOMS AND HOSPITALS.

COOLING OF BARRACKS.

Dr. Dempster's note, p. 468, fol. ed. Vol. I.

The usual means of cooling the air, and obtaining a freer movement of it, in barrack rooms and sick wards is by punkahs suspended from the roof and pulled by natives. This, which is an Indian practice, appears to answer, except at the hottest stations, where other means are used. These consist generally of frames filled with mats of kuskus grass fitted into certain of the doors or windows, and kept constantly watered by natives. When the doors and windows are all provided with these "tatties," and the only air which enters the room is that which must pass through the tatties, a considerable reduction of temperature takes place, but it frequently happens that doors are left open, and the cooling effect is reduced.

At some very hot stations "thermantidotes" are used. These are merely a copy of the ordinary winnowing machine, in which the air entering to supply the fan is made to pass through a wetted mat. They are said to answer their object as in hospitals.

1320. Other two plans have been brought before us for cooling the air. One of these by Captain Moorsom is merely a set of tatties moved by machinery and kept moist by water. It is intended to be more constant and efficient. and at the same time more economical, than the present system.

5662. Another method will be found described in the evidence of Mr. Siebe. It is a machine for making ice by steam power, and might be used also for cooling water or air, where the cost was no great object, as in hospitals.

Ablution and Bath Accommodation.

Ablution and Baths.

At home stations ablution rooms are a modern concession to cleanliness, and it is only now that the extent of accommodation provided is becoming sufficient for the soldier's wants. In India, where the means of cleanliness require to be so much more abundant and accessible, they are deficient almost everywhere. At the large station of Peshawur, where there were between 1,600 and 1,700 European troops, there were no ablution rooms in August 1860. At another large station, Deesa, a washing room is attached to each barrack, but there are no conveniences for washing in it. The usual arrangement is to have stone benches along the wall; water is carried by bheesties, and iron basins are used for washing, as at home. None of the ablution rooms are drained. The foul water is simply conveyed to a cesspit, from which it is carried away by hand or allowed to sink in the ground. At some of the larger stations fresh water is conveyed to a cistern from which it is distributed to the basins by taps. At many stations the ablution rooms are dark and damp, and with a few exceptions, the ablution accommodation admits of great improvement.

Vide abstract of Stational Reports.

Deputy Inspector-General Stewart states that the means of personal ablution at all stations are more or less deficient; that in some barracks they can scarcely be said to exist, and that the rooms are dark, confined, and inconvenient even for washing the hands and face; that the men do as they best can, and wash themselves perhaps in the open verandah, or in a small room at the end of it. 761-2-3.

This is confirmed by Dr. Bird, and by Colonel Greathed, who state that the ablution rooms in barracks are generally imperfect. 3507. 3107.

At many stations there is more or less bath accommodation. Generally it consists of a plunge bath. In some cases baths of a smaller size are used. There is no bath for the large garrison of Fort William, where baths are urgently required.

Colonel Greathed says that the bath accommodation is sufficient for perhaps two companies, bathing every second day, although it is considered advisable that there should be a bathing parade in India every day during the hot season. The objection to this is the cost of the water-supply, which has to be drawn and carried by men and bullocks. It is indeed the same objection that would exist at home if water had to be provided to any extent as it is in India. But it is found possible to supply extensive bathing establishments with water by improving the method; and hence the present system of Indian water-supply is directly opposed to keeping up a proper system of ablution for cleanliness and health. 3117. 3119.

It is obvious that the ablution and bath accommodation require to be placed on a better footing, and that this cannot be done without a better system of water-supply. In situations where the water-supply is limited, shower baths on a large scale might be introduced with advantage.

Cook-houses.

Cook-houses.

Vide abstract of Stational Reports.

The means of barrack cooking are of the simplest description. They usually consist of a small detached room or shed, without any chimney, and insufficiently lighted. Along the walls there are low platforms of masonry, with square holes to hold the fire. There is neither water-supply nor drainage. All the water is brought by water-carriers, and the refuse water is either allowed to escape as it best can, or it runs into a cesspit, and is removed by hand labour. The cooking utensils are very simple; but through the ingenuity of the native cooks almost every variety of dish can be prepared. The men like the cooking, but experienced medical officers do not consider it always wholesome. There is a large consumption of fuel, the smoke from which fills the kitchen and blackens its walls. Recently improvements have been introduced in the cook-houses of Fort St. George, Madras, by an army medical officer, who has adapted a set of boilers and oven on Captain Grant's plan, of which it is a modification. The food is said to be better cooked, and at less expense, both for fuel and attendance.

However imperfect the Indian cooking may be, it admits of great variety. And though modern improvements need to be introduced, yet it is by no means in the rude state in which home barrack cooking was found in 1858.

Latrines and Urinals.

Latrines, &c.

Abstract of Stational Reports.

These conveniences are usually placed in outbuildings at a short distance from barracks, and sometimes connected with them by covered passages for protection against sun and rain. They vary in construction at different stations. Those belonging to the older barracks are cesspits cleansed from the outside. In more recently constructed barracks metal pans have been introduced to facilitate the operation of removal. There is no drainage of any kind, and the arrangements altogether are very offensive. The only object attained is rapid removal of excreta to be buried or otherwise disposed of at a distance. In every other respect the latrines admit of great improvement.

Drainage, and the removal of excreta by water, is now universally considered to be the most economical and least injurious method of disposing of them; but there is some doubt whether these improvements would be applicable to all Indian stations. In certain low, flat districts, where there is little fall for drainage, this might probably be the case; but there are many stations in which drainage might be carried to an available outlet, and iron water latrines and urinals, properly supplied with water, introduced.

Many of the buildings require light and ventilation, and none of the latrines have the recent improvements of divisions and doors which have been introduced of late years at home.

Wherever cesspits exist they should be abolished, and movable vessels or water latrines substituted for them.

Officers' Quarters.

Officers' Quarters.

Officers are generally lodged in detached bungalows, situated within compounds. Their sanitary condition is described in the stational reports as being good. But at some stations complaint is made that sufficiently good accommodation cannot be rented, because it does not exist. The great advantage, as regards health, possessed by officers is living in detached buildings, with free external ventilation. But their quarters partake of the general sanitary disadvantages of the station as to drainage, water supply, &c.

Quarters for Married Non-commissioned Officers and Soldiers.

Married Quarters.

Great improvement has been made in India of late years in providing this class of accommodation, It usually consists of separate huts or bungalows, of two or three rooms, built in the patchery, a court belonging to the barrack. In a few instances there are barracks for the purpose. In about 20 per cent. of the stations no separate quarters have yet been provided; and married people are lodged in barrack rooms divided by mats. There are two or three instances in which married people occupy the same rooms as single men, separated from them by mats. At two-thirds of the stations the married accommodation is said to be sufficient. In some of these cases there are from 80 to 120 separate married quarters. At about one-seventh of the stations where married accommodation has been provided it is said to be insufficient; and at two or three stations it is described as bad.

Abstract of Stational Reports.

The general sanitary condition of the married quarters partakes of that of the station. But the men living in patcheries with their families are much more healthy than men living in barracks

Occasionally, from want of care, considerable overcrowding takes place in these quarters; and in one instance at least it was attended with frightful results. This occurred at Dum Dum, where a large number of women and children were lodged together in barrack rooms, without due care having been exercised as to the amount of space, or ventilation, or as to other sanitary arrangements.

2172–80.

There was an average monthly strength of 554 women, among whom there occurred 64 deaths in 5 months; and there was an average monthly strength of 770 children, out of whom died 166 in the same five months.

The annual ratio of mortality among the women would accordingly have been 276 per 1,000, and among the children 516 per 1,000; the usual proportions for Bengal being, deaths per 1,000, women, 44; children, 84.

The diseases of which so many perished were, dysentery, fever, and cholera. And the causes were intemperance, immorality, reckless exposure, unwholesome food, want of cleanliness, personal and general, and a polluted atmosphere.

The effluvia from the privies were perceptible in the barrack rooms.

2218–19.

This calamity may have been exceptional; but it clearly shows the class of causes which exert the most destructive influence on

MARRIED QUARTERS.

European constitutions in India; children being there, as elsewhere, the most delicate tests of sanitary condition. The experience admits of application to all barracks where there are European soldiers; and it gives an insight into the causes of high mortality of children in these climates.

TENTS.

TENTS.

Stational Reports.

Tents for camp or field service are of various forms and dimensions. Some are square, others are oblong or oval formed, some are circular, and others have a pyramidal section. They have some one, others two poles; and they vary in length from 11 to 22½ feet, in breadth from 10 to 14 feet, and in height from 8½ feet to 13 feet, within the inner lining. They consist of three or more layers of cloth, according to its quality, the inner layer being generally of a blue colour.

These tents accommodate a greater or less number of men, 14, 16, or 22 men, according to the arm of the service which has them in use. Their cubic contents vary from 935 to 2,835 feet, the superficial area of the floor varies from 9½ feet to 24½ feet per man, and the space per man varies from 77 to 220 cubic feet. The double poled hospital tents are larger and better than the others. They afford 26 square feet, and 236 cubic feet per man for 12 men.

None of the tents are ventilated, except by opening the doors and raising the walls; but this of itself is not sufficient. Ventilation round the poles at the top is indispensable, to keep the air in the tent sufficiently pure, and the spaces between the different layers of cloth should also be ventilated, to afford a means of escape for the air heated by the sun's rays. Abundant means of admitting fresh air, and allowing of the escape of foul and heated air above, can alone compensate in any degree for the overcrowding to which all tents are liable.

Objections have been made before us to the whole structure of the present Indian tent, by Mr. Jeffreys, who proposes a totally distinct form, as being much cooler and more healthy, and affording a larger space per man. We refer to his evidence for a description of the tent he proposes.

2831.

DIET.

DIET.

At every station in India the British soldier is supplied with a full ration, including the following constituents:—

Meat, 1 lb.	Rice, 4 oz.	Coffee, 1⅜ oz.
Bread, 1 lb.	Sugar, 2½ oz.	Salt, 1 oz.
Vegetables, 1 lb.	Tea, ⅘ oz. or	Firewood, 3 lbs.

The foundation of the ration is beef and bread. Mutton is issued in lieu of beef twice a week, when procurable. The pound of vegetables consists of potatoes, when procurable, carrots, onions, pumpkins, &c. There are complaints that the issue of mutton is too small, and that vegetables cannot always be procured in sufficient quantity. But generally the ration is considered good. The

stoppage is about fivepence (3 annas, 4 pie). The cook generally supplies some trifling articles in addition, such as meat for breakfast, milk, and sometimes butter, &c., for an anna a day. The large bone is separated from the meat before it is weighed for issue by the Commissariat.

The captains engage the cooks, just as they would engage washermen, and the charge for cooking is 10 to 12 annas per month. Not unfrequently the men, if they have money, will buy 2945. bacon and pork, badly and filthily fed; for the bazaar pigs are the bazaar scavengers. And thus, whatever care may be exercised by Government in providing healthy food, the men and the cooks may add meat which is quite the reverse. In addition to all this, the soldier may add 1 quart malt liquor, or 2 drams spirit, per diem.

The first thing that occurs in considering this system of diet is, that it would be amply sufficient for the sustenance of men engaged in out-door toil in a cold climate. Indeed, we very much question whether labouring men at home consume so large an amount of nitrogenous and carboniferous food at any ordinary time. In India it would be enough to supply the requirements of the hardest work the climate would admit of. But, at the same time, there is 3521. a certain exhaustion produced by the climate and the manner in which the soldier passes his time, which makes the present ration apparently no more than sufficient.

The soldier has three meals a day: breakfast at seven or eight in the morning, consisting of tea or coffee, with bread and often meat; dinner at one p.m.; tea about five, sometimes with meat too. The dinner is therefore eaten just before the hottest part of the day; and all the meals are crowded into nine or ten hours of inaction.

In considering the influence of this on health, we must be guided by other facts.

In the first place, the natives who are accustomed to the climate 2942. eat very little animal food, particularly in hot weather. This native habit, which is the result of a natural instinct, is in strict conformity with physiological law. Besides providing for the waste of the body by exertion, part of the food goes to supply animal heat. But where there is little or no exertion, and where the climate is hot at the same time, the amount of food necessary for health is much less than it would be in a cold country under hard work. Some useful experience on the effect of over-feeding in tropical climates has been laid before us by Staff Surgeon Dr. Rennie, for several years in medical charge of convicts in Western Australia. In his evidence, and in a note appended to 870. it, he states that over-feeding and the too free use of animal diet produced much disease, including dysentery, among the convicts: that by reducing the amount of both, improved health followed, and that a further reduction in the scale of diet, with other improved sanitary conditions, led to a very remarkable improvement in the general health of the prisoners. He states it as his opinion that what are familiarly known as "the diseases of tropical

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"climates," are in reality diseases resulting from habits and circumstances of life generally unsuited to tropical climates, and that the relation which food (including alcoholic stimulants) bears to temperature is seriously overlooked in the dieting of bodies of men in the public service.

The soldier in India has not sufficient occupation to keep him in health; and under such a system of dieting, as he at present undergoes, he must suffer, more or less. By overloading the system with useless elements, the digestive and biliary functions become disturbed, and a predisposition to disease is induced. For this state of things, the soldier should either have work or exercise provided, sufficient for his diet; or his diet should be made to accord better with his sedentary habits. No general rule can be laid down in this matter, applicable to all circumstances. But one thing is quite clear, that the soldier should have more exercise, and that the same diet which may be consumed in the cold season with safety cannot be the most suitable for heat. Dr. Dempster tells us that it is certain that the majority of the recruits from Ireland and Scotland eat in the hot weather in India many times the bulk of animal food ever consumed in their native country while working hardest in the coldest season of the year. And that the same quantity of animal food and stimulating drinks taken with advantage by a working man in a cold moist climate is not only unnecessary, but positively injurious to the almost idle European soldier in the burning plains of Hindostan. So little is the importance of the difference of climate recognized that the soldier eats animal food twice or even thrice a day all the year round. Sir John Lawrence says that he does not believe the officer does so, and that if he does, he gets sick too. The evidence before us goes to prove that the present dietary of the soldier considered with reference to the amount of work he has to do is injurious to his health, and we concur entirely in the opinion of Sir John Lawrence that Government might try to induce the men, by varying the ration, with reference to hot and cold weather, to use more vegetable diet and fruit, and less animal food.

Page 484 *post.*

2943.

2946.

The regimental medical officer is indeed charged, by the new medical regulations, with the duty of making such representations on this subject to his commanding officer as he may deem necessary for the health of the troops, so that the principle of change is admitted.

DRESS.

DRESS.

Much interesting and valuable information on the subject of the soldier's dress in India will be found in the stational reports and in the evidence, and several important suggestions for improving some of its details have been laid before us, particularly by Mr. Julius Jeffreys, who has paid much attention to the subject.

2860.

The dress of late years has undergone great and beneficial changes, and is now much better adapted to the climate, seasons, and duties, than it was in former times.

DRESS.

The soldier now wears habitually a khakee (dust-coloured cotton) tunic and trousers, and a helmet made of wicker work. The collar is made to fasten with a hook and eye, and no stock is worn except in cold weather. 3238.

As regards under-clothing, the evidence is in favour of wearing light flannel next the skin, especially at stations subject to sudden changes of temperature, and under exposure. 80-83.

Sir Ranald Martin considers that the evaporation from the surface of the body is so great in India that a slow conducting medium next the skin is absolutely necessary, and that dysentery and liver disease are frequently produced by chills. Flannel moderates the evaporation from the surface of the body, apparently without heating it, for Mr. Jeffreys states that he has repeatedly ascertained the temperature of the skin in hot and dry weather to be much lower under flannel with a cotton dress over it, than under cotton alone. 2886. The value of flannel in preserving health has been long known to army officers, and the main objection to its universal introduction is the difficulty of washing; but on the other hand this objection does not apply with much force to its use in India where labour is so cheap.

The present head-dress is formed for the special purpose of protecting the head from the sun's rays, which it does with considerable efficiency; but several ingenious improvements in it have been laid before us by Mr. Jeffreys, which are worthy of examination. 2860–2874. He proposes to make the outer shell of the helmet double, with a ventilated space between the layers, and within the shell there is a lining to fit tight to the head, leaving another ventilated space between the inner surface of the shell and the wearer's head.

The object of the contrivance is to ensure the passage upwards of two distinct currents of heated air between the outer shell of the helmet and the head. In order to diminish the power of the outer shell to absorb the sun's rays, the inventor proposes to cover it with a thin highly-polished metallic surface.

In proof of the great importance of giving every attention to the subject, it is stated that between the years 1830–45 the annual mortality among troops in Bengal was nearly 30 per 10,000 from apoplexy alone; that in particular instances the mortality from this disease has been as high as 500 per 10,000, while the deaths from the same disease in England were less than 2 in 10,000. 2883.

Mr. Jeffreys also mentions that excessive heat on the brain produces moral depression, even among the best troops in the service. Sir R. Martin concurs in this opinion. 2881.

Our attention has been called to one other matter of dress,—the boots, which, as at present issued to the soldier, do not fit well. They are made at home on a very few models and sizes, and when sent out to India are found in very many cases not to be wearable. Colonel Greathed states that in his regiment the men never used them, and that they were taken to the shoemaker's shop and made over again at a certain cost. 3243 3244.

DRESS.

In the report from Ahmednuggur it is stated that the present system of serving out boots of similar shape to men with differently-shaped feet "cannot be too much reprehended," and that a better system, although somewhat more troublesome and costly, would be amply repaid by increased efficiency. The reporters suggest that "upper leathers" and soles should be sent out to India, all of the largest size, and made up to fit the men by shoemakers attached to each company.

Either this course should be followed or a larger variety of sizes provided. The simple fact mentioned by Colonel Greathed is sufficient to prove that a change of system is required. Foot-lameness from badly fitting boots admits of no excuse. Of all causes of inefficiency in an army it is the most unjustifiable.

INTEMPERANCE.

INTEMPERANCE.

Stational Reports. Page 314 *post.*

According to existing regulations, every soldier has a right to purchase at his regimental canteen two drams of spirits of good quality, generally rum or arrack, supplied by the Commissariat; or he may substitute malt liquor, wholly or partially, for spirit. The quantity of malt liquor issued in lieu of spirit varies in different regiments, but generally it appears to be a quart in lieu of a dram. Formerly spirit used to be issued as part of the ration, and it could be obtained early in the morning; but of late years this practice has been almost, if not altogether, discontinued. No intoxicating drink is issued before dinner, but every soldier has a right to purchase the quantities of spirits or beer stated above. Beer can be removed from the canteen for dinner, but spirits must always be drunk at the bar; and in order to prevent a double issue, a non-commissioned officer attends in the canteen and registers the men's names who have received their allowance. In some regiments no spirit is allowed to be issued until evening.

Two drams of spirit are equal to the twentieth part of a gallon, and hence each soldier who avails himself of his privilege of dram-drinking to the fullest extent, will consume 18¼ gallons of raw spirit per annum; but most men content themselves with one dram and an equivalent of malt liquor.

Several very serious questions arise out of this practice of continual dram-drinking, as it affects the health and efficiency of the army in India. In colder climates it is known that there is scarcely a habit to which men are addicted which so surely and steadily undermines their health and predisposes them to organic diseases as the daily use of spirituous liquors. It disorders the digestive functions, irritates the nervous system, occasions structural disease of the liver, brain, and bloodvessels, and is a most potent predisposing cause of cholera and other epidemic diseases. A simple statement of these well-known effects of continued tippling is sufficient to show that of all habits it is about the last which should be indulged in or encouraged in such a climate as that of India; for the diseases which it is observed to cause in this country are diseases from which the soldier suffers severely

in India. Liver disease, delirium tremens, sun-stroke, and apoplexy, as well as cholera, prevail to a large extent all over India, besides a number of diseases which are indirectly traceable to intemperate habits. A striking illustration of the evil results of even casual acts of intemperance is given by Dr. Bird, who mentions that on one occasion a great mortality took place in the horse artillery. Apoplectic seizures, cerebral symptoms, and fever struck them down. "We marched," he says, "through a great "number of date-trees, where the men pulled down the pots that "are attached to the trees; they could pull them down, and drink "the contents." "Toddy and the sun" killed them; but the deaths were laid to the account of the latter.* Intemperate habits are also the most fruitful causes of indiscipline and crime. INTEMPERANCE. 3581–2.

At some stations the proportion of cases received into hospital, directly or indirectly the result of intemperance, appears to be about a tenth part of the total admissions from all diseases; and there is a remarkable concurrence of testimony in the reports of the different stations as to the injury to health generally caused by the use of spirits. Some medical officers go even further, and object to the use of malt liquor in such a climate, and propose to substitute for it light wines, ginger beer, tea, coffee, &c., for the reasons stated by Dr. James Bird that "it is a physiological "principle that any hydrocarbonized drinks, whether beer or "spirits, are more objectionable to men going to a warm climate" than the less stimulating drinks we have enumerated. Abstracts of Stational Reports. 3546.

The same evil results of intemperance have been traced among the civil European population. Dr. John MacLennan states, that in one hospital at Bombay the amount of disease admitted from intemperance was "something appalling;" that nearly one tenth part of all the admissions during a period of 10 years were from delirium tremens and ebrietas; that, with the sole exception of fever, the number of admissions was larger than from any other disease; and that, as to deaths, "alcohol destroyed more "than either fever, hepatitis, or diarrhœa, and nearly as many as "cholera." About a third part of the victims of intemperance were soldiers and pensioners. 1229.

We are glad to say that in some regiments habits of temperance have been introduced, and with marked benefit to health.

Mr. Dempster instances the case of the 2nd troop, 1st brigade, Page 485 *post.*

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* Referring to the effects of drinking ardent spirits, Sir Charles Napier says:— "Drinking does not give the fever, but it so inflames the liver and brain, that "the fever takes too firm a grasp to be got rid of. Why! their ration is *two* "*drams* a day, and *eight* of these drams make a *quart bottle!* so the sober soldier "swallows *one-fourth of a bottle* of raw spirits every day! You and I know them "too well to doubt that the other three-fourths go down after the first. Dr. Robin- "son, of the 13th, a clever man, supposed to know India better than most others, "tells me that at Jellallabad, where no liquor could be had, where they could get "only water, he had not a sick man the whole time! The great disease *with officers* "*and men is drink, but the soldiers drink worse liquor, namely, arrack, which is made* "*with anything and everything but rice.* Rice, the wholesomest of all Indian produce, "is sadly belied. *This arrack* is made chiefly of *bhang*, a liquor drawn from the "date tree, not by distillation, but incision in the bark."—Napier's Conquest of Sinde, p. 530.

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horse artillery, in which a temperance movement was introduced at Meerut, and only 20 men drew the spirit ration, the remainder either drinking moderately of malt liquor or abstaining altogether. He states the effect to have been excellent, and that he "had "never before seen European troops in India in so good a condi- "tion in all respects;" that when the troop arrived at Meerut from Loodiana it had 50 per cent. actually in hospital, and that after a four years' residence in Meerut, under the temperance system, it marched to Sealkote "with a clean bill of health, no death having "occurred among the men for a period of two years." It is, however, but fair to state that Meerut is a comparatively healthy station.

2390, 2391.

The 26th Cameronians, while under the command of the late Colonel Oglander, is cited by Dr. Maclean as a temperance regiment, whose health was "admirable" up to the time of their landing at Chusan, where they were destroyed by bad food and bad locality, until at the end of two months they could not muster 20 men. While they were at Fort William they had only about a third of the sickness under temperance which they suffered from under dram-drinking. They landed in China 900 strong, and there was not a single man in the regiment, except the old soldiers, who drew his spirit ration.

Appendix 2nd, to Kurrachee Report, vol. 2, fol. ed.

2390.

Dr. Maclean also mentions a remarkable illustration of the beneficial effect of temperance in the 84th regiment, under the command of Colonel Russell, while it was stationed at Secunderabad, which has been hitherto one of the most unhealthy spots in India. The Irish Roman Catholic priests in the regiment promoted the temperance movement so effectually that there was scarcely a man in the regiment who drew the spirit ration; and he says, "as might be expected, it was one of the healthiest regiments "I ever saw in Secunderabad."

1355, 1356.

Another similar fact is mentioned by Dr. Colvin Smith as having occurred at this station. He says that the 3rd Madras European regiment was remarkably healthy at Secunderabad in 1856; and when his attention is called to the fact that this healthiness is an exception to the rule, he states that it is to be accounted for in this way, "that they got rid of all the grog shops about the lines, and "that improved the health of the regiment immensely."

Vide also Stational Reports.

The whole tenor of the evidence, then, goes to prove that the consumption of ardent spirits by the troops is a very potent cause of disease in India, and that much benefit to the efficiency of the army would accrue from discontinuing its use, if it were practicable to do so.

It is upon the practicability of effecting this great reform that the whole question turns.

The use of spirits habitually is an acquired taste, which after a time becomes confirmed. The habit exists throughout the British army, and is carried with it to every station at which it serves, whatever may be the climate or its dangers. It is this depraved taste which lies at the root of the whole matter, and which renders it so difficult to deal with the question.

Throughout the army, drunkenness is punished as an offence, and at all home stations the sale of spirits is forbidden in the canteens. So far, the habit meets with discouragement. INTEMPERANCE.

The introduction of libraries, reading rooms, schools, good conduct badges, amusements of various kinds, and savings' banks are encouragements to temperance which have been introduced of late years.

It is considered to be unnecessary at home stations to permit the sale of ardent spirits in canteens, because no danger can accrue from the prohibition, while, at the same time, their use is, to a certain extent, discouraged.

But at most foreign stations, and throughout the whole of India, it has been considered advisable to permit the sale of ardent spirits, under restrictions as to quality and amount, in all canteens; because bad, adulterated, and, in some cases, poisonous spirits only could be otherwise obtained by the soldier.

The permissive, authorized sale of spirits, the use of which by the troops we have shown to be an indirect cause of a large amount of disease and mortality, thus becomes a direct encouragement to intemperance and disease, while its avowed object is to prevent disease by supplying men with a less injurious spirit than they could otherwise obtain.

There are also certain financial advantages derived from this monopoly of sale, which are thus described by Colonel Greathed:—

"3185. You say that the soldier derives a certain pecuniary benefit from the canteen fund, will you explain to the Commissioners how that arises?—It is from the enhanced price at which the spirits are sold,—8 annas or 1*s.* is imposed upon every gallon of spirits, and that in a very short time creates a fund which supplies the wants of the soldier without any expense to himself; for instance, the canteen fund, under the regulations of the Government, pays for the cap covers of the men, which are very necessary, and a constant expense; it also pays for all his amusements,—the fives court and the theatre, the skittle ground and the gardens, and in fact any reasonable request which the commanding officer makes is always granted.

"3186. When we speak of the Government providing soldiers with a fives court, or other means of amusement, we mean that, in point of fact, the soldier provides these for himself by the tax which is levied on spirits, and which is levied on spirits exclusively?—The fives courts are always parts of the barracks; the theatres are certainly maintained by the soldiers, or by the regiment; the men subscribe to them. The theatre at Jullundur was bought; we paid 300*l.* for it, and that money was paid out of the canteen fund entirely; that the Government did not give at all: and, in fact, everything connected with the amusements and comfort of the men is paid for out of the canteen fund."

In the appropriation of this fund, Colonel Greathed states that the fund accumulates in "a wonderful way," and that the great difficulty is to keep it down. After 3,000 rupees are accumulated, the Government may lay its hands on the fund; and it is the object of the officer commanding the regiment to spend it as quickly as he can. 3190.

It appears then that there is a tax on spirits which is applied in India to purposes and objects which are met in a totally different way at home, and that there is a direct pecuniary interest in the soldier consuming spirits up to the full extent of the regulation allowance. There is, as it were, a tacit encouragement for the

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soldier to drink that which is admitted to be injurious to health, in order that he may be benefited in other ways, which may be conducive to health. So long as this pecuniary interest is recognized, it will be impossible to deal effectually with the evil. Government in India should cease to have anything to do with such a source of revenue, in the same manner as it has done at home; and whatever is necessary for the soldier's health and recreation should be otherwise provided for.

3194. Colonel Greathed says, "I cannot defend it. Let the Government give the money, and the thing might be done. It is a "question of money."

As regards the danger of bad or adulterated spirits being obtained by the men, there is an all but universal belief that if the supply at the canteen were discontinued, the men would be injured by drinking bazaar spirits.

Distillation appears to be carried on to a large extent all over India, and in every bazaar there are places where spirits of some kind can be openly bought or otherwise obtained at a very small price. This spirit is stated to be very unwholesome, and often adulterated with poisonous drugs, such as stramonium, &c., to increase its intoxicating power. It is not very strong, but it is so cheap that a man may intoxicate himself for three halfpence, or less. It is allowed to be sold in the bazaars, but not to soldiers, under severe penalties both as regards the vendor and the man himself.

One of the most difficult and important duties of the bazaar magistrate is to keep the soldiers from obtaining this bad cheap liquor, which he does manage to procure notwithstanding the facilities afforded by the canteen and the penalties to which he subjects himself.

65. Sir R. Martin says, "restrictions are always attempted, but "then the evil of open cantonments throughout India, is the "difficulty of maintaining a proper system of medical police, "especially in regard to the use of the pernicious bazaar spirits." Testimony to the same effect is given by other witnesses, and, indeed, the difficulty of preventing the sale of bazaar spirits to soldiers is the only reason alleged in the stational returns for the continuance of the present canteen system. From nearly every station, and from all classes of officers, there is the same expression of opinion, that the use of spirits by the troops is neither conducive to health nor discipline, and that it ought to be abolished were it possible to prevent the consumption of bazaar spirits.

Notwithstanding every effort, it is to be feared that the cheap spirit will always cope successfully with the dear spirit; and the whole evidence leaves it very doubtful whether, considering the encouragement given to men to drink spirits in the canteen, confirming their bad habits, and the cheapness of the bazaar spirit which they manage to procure, the present canteen system is of any use in protecting the soldier's health.

Stational Reports.

The testimony in favour of the use of malt liquor is nearly as unanimous as the testimony against the use of spirits. Some

medical officers, indeed, consider that it would hardly be safe even in India to deprive old spirit-drinkers of a long-accustomed stimulus; but admitting that such cases exist, they in no way detract from the weight of testimony on the other side, because the cases put forward are exceptional, and are indeed those in which a medical officer would in all probability prescribe alcoholic stimulants as medicines. Indeed it would not be advisable to exclude the use of spirits altogether from the army. There are cases, such as those alluded to, and there are particular kinds of service, as, for instance, field service, or duties exposing men to wet or damp, or very great fatigue, where a temporary stimulus would be of use, and where an issue of spirit under the advice of the medical officer might be permitted. But it is now known that many of these temporary uses to which spirits can be advantageously applied are much better met by tea or coffee, both of which have the special virtue of preventing waste under exertion, which spirit has not. Indeed there can be no doubt that a more systematic use of these beverages during times of fatigue and exposure would conduce more to the health of troops than any temporary issue of spirits.

Admitting, however, the existence of these exceptional cases, the weight of evidence is strongly in favour of malt liquor when compared with spirits.

Speaking of the comparative effect in India on health of the use of these drinks, Deputy Inspector-General Stewart says— 803.

"I believe the majority of soldiers would greatly prefer malt liquor to spirits, and the only reason for their not using beer almost exclusively is, their means being insufficient to procure it. I also feel assured that the use of malt liquor is far more conducive to health than that of spirits: I believe it would also lead to less crime and irregularity. I have further observed, that the consequences of prolonged over-indulgence in malt liquor are more manageable and less fatal in their result than when produced by a similar abuse of spirits."

Deputy Inspector-General Dempster in his paper says— Page 485 *post.*

"Although I am of opinion that the freshly arrived European does best to confine himself to pure cold water or slightly acidulated drinks, yet if good malt liquor is only to be considered a substitute for rum, I would advocate its use from the very first."

These opinions of experienced medical officers give the substance of most of the evidence on the subject which will be found in the stational reports; but it must not be considered that malt liquor is advocated as a drink which it is indispensable for the soldier to use; the evidence only goes to prove that malt liquor is very greatly less injurious to health in a warm climate than spirits.

We have already quoted what Dr. James Bird says on the subject. His evidence is against malt liquor and in favour of lighter drinks, and other witnesses give equally guarded opinions: thus, Dr. John McLennan says, "I apprehend that beer or porter "ought to be taken with considerable moderation if health is to "be retained in India"; and when he is asked, "But do you "not think that a comparatively liberal use of beer or porter "would be far less injurious than an unlimited use of ardent "spirits?" he replies, "I think it would produce a different 3546. 1205, 1206.

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"class of disease. I believe that great beer-drinkers and great "porter-drinkers do suffer."

Light wines, and temperance drinks of various kinds, tea, and coffee, are certainly those which would meet the case as regards health most effectually, were it possible to secure their use by the troops; and perhaps as great an inducement to sobriety as any of them, would be a plentiful supply of pure filtered cold water, obtained from fountains or water-taps at convenient places all over the stations.

5650. The Indian Government has been put to an expense of nearly 200,000*l.* a year in supplying malt liquor from home for the troops in India, in order to place it within the reach of the men. And as the daily use of malt liquor is not necessary to health, this large sacrifice of revenue can be considered in no other light than as a tax to encourage men not to drink spirits, and is a striking evidence of the cost incurred by the intemperate habits of the British soldier. If the loss to the service from diseases occasioned by intemperance were added to this premium on the consumption of the less deleterious drink, it would amount to a very large item in the whole cost of the army.

5651, 5652. One of the advantages of hill stations is stated to be that, on account of the lower temperature of the climate, beer could be brewed at them, and a great public saving effected thereby.

Page 482 fol. ed. Vol. 1. This has already been tried by Lieut.-Colonel Ouchterlony and others. But the nature of the materials at their disposal and other circumstances rendered their success only partial. He, however, thinks the question of establishing breweries in India worthy of consideration by capitalists.

5654, 5657. Sir A. M. Tulloch is strongly of the view that beer should be brewed at all the higher stations, and the great cost of carriage saved.

The whole subject, indeed, is of most serious importance, and every inducement to temperance should be held out. Any change would have to be gradually introduced, beginning with young soldiers, and discouraging to the utmost the use of spirits, until the stigma of spirit-drinking be wiped off from the British army. The present inactive weary life which the soldier leads in warm climates powerfully fosters the habit of intemperance; and every facility for useful work and for rational instruction and recreation should be afforded him.

VENEREAL DISEASE.

VENEREAL DISEASE.

Venereal Disease, a frequent concomitant of intemperate habits, and, like these, fostered by want of occupation, is another of the causes enumerated as laying the foundation for ill health in India. It prevails to a very great extent in the army, and at almost every station. The proportion of venereal cases constantly in hospital is usually from 20 to 25 per cent. of the total sick. At some of the larger stations it very much exceeds this amount. At Bangalore and Roorkee the proportion at the time the return was made

up was 50 per cent.; at Dinapore it was as high as 53 per cent.; and its influence on efficiency may be judged of from the fact stated by Dr. Maclean, that in the 1st Madras Fusiliers, a few years ago, the amount of syphilis was equivalent to the withdrawal from duty of one-fourth of a company daily. Many of the cases are of course of a slight character, but a considerable number become very serious in their progress, and render the men unfit for service. Many invalids are sent home from this cause, and in numerous other cases the constitution is undermined, and the patient becomes liable to other diseases. VENEREAL DISEASE. 2393.

There is no subject so difficult to deal with as this; and almost every plan for lessening the evil has been tried and found to fail. They all resolve themselves into two classes, namely, repressive measures of police, or marriage and moral restraint.

Many of the stational returns contain recommendations for the establishment of lock hospitals, and several witnesses have also strongly recommended them. They were introduced many years ago into India, but their use was after a while discontinued. The amount of venereal affections among the troops in all three Presidencies is so large (in 1860 it was 345 cases per 1,000 of the strength in Bengal, 249 in Madras, and 314 in Bombay) that there is an urgent need of some remedial measures. After considering the various plans which have been adapted in different countries, we have arrived at the conclusion that none are so likely to diminish this great scourge of the soldier in India as the re-organization of the measures formerly adopted in the three Presidencies, with any improvements which subsequent experience and consideration may point out as being required to meet the necessities of each locality.

Additional means of cleanliness, such as have been recommended by Mr. Acton, ought to be provided in all barrack lavatories. They would materially diminish the liability of the troops to this class of diseases. 4010.

It is observed that among native regiments, where marriage is not restricted, this disease is much less frequent than in European regiments, in which marriage is restricted.

There are no means of knowing precisely to what extent these facts stand to each other in the relation of cause and effect, but they have led to certain proposals for increasing the proportion of marriages in the army. The present proportion of married soldiers in Her Majesty's regiments who have a claim for accommodation in barracks is 6 per cent. of the force (exclusive of serjeants) at home, and 12 per cent. in India. Since the amalgamation of the two services any augmentation in the number of marriages specially to meet the case of India would probably involve a change in the regulation throughout the army. Even at present, and with the existing per-centage, the number of women and children in a regiment is a very serious affair, and leads to much expense as well as suffering. It is beyond our province to decide what should be the proportion of marriages "with leave" for the whole army. Men of great experience consider that the proportion should be increased. Married men are generally the most healthy; they are the best soldiers, and a certain number of them are an example

VENEREAL DISEASE.

in a regiment; but when the regiment goes on foreign service a certain proportion of women only can be taken with it: and thus, so far as India is concerned, any large increase in the proportion of marriages would lead to wives and children being left behind, and exposed to much temptation and possibly to distress, while the domestic tie cannot fail to be weakened by long protracted absence. Some excellent remarks on the subject will be found in Miss Nightingale's paper.

Pp. 339–40.

There is one means of reducing the temptation resulting in sexual disease, which ought to be encouraged, and that is to improve the soldier's condition in the way of occupation, instruction, and recreation,—in fact, to occupy his wasted time beneficially and rationally. The late General Jacob was fully aware of this, when he stated that "moral forces alone are of any value."

Vide Appendix 2, Kurrachee Report, page 492.

So far as we can deal with this question, occupation appears to us to afford the most reasonable hope of diminishing this great scourge, by leading men away from the canteen and from vice.

MEANS OF RECREATION AND INSTRUCTION.

RECREATION, &c.

There is no period of military service in which the soldier is thrown more upon his own resources, and has fewer opportunities of employing them advantageously, than during his service in India. He rises at gun-fire, attends his parade or drill, over soon after sunrise. He then returns to his barrack, and during the hot season he is not allowed to leave it till late in the afternoon. At one o'clock he consumes a large amount of both animal food and vegetables, porter (perhaps a quart), and spirits. He has few or no means of occupying himself rationally. He lies on his bed and perhaps sleeps most of the day. He has his evening parade or drill, and his turn of guard duty once every five, seven, or ten days. Even at home this kind of regimen would be far from conducive to health. In India, both physically and morally, it helps to destroy it in men in the prime of life, with abundance of nervous power to dispose of.

Pp. 319–323 *post.*

The whole of this unwholesome proceeding is considered necessary for preserving the soldier; but it is not considered necessary to subject the officer to the same ordeal. He goes about, and even goes shooting, not only without detriment, but with great advantage to health; for the officers are much more healthy than the men.

Some means of passing the time are provided for the soldiers at all stations.

3206. Stational Reports.

The usual games are long bullets, quoits, fives, and cricket; and almost every station has a ball-court and skittle-alley.

There are also libraries, and sometimes a theatre.

Soldiers' gardens and workshops have been tried at a few stations; but there are no covered places for exercise or for gymnastics.

The scale on which the existing means have been provided is the same as the very imperfect provision at home, without reference to the climate or to the much greater need of inducements to exercise, which require to be held out in India.

Recreation, &c.

The men's amusements, such as they are, are always connected, more or less, with drink; and they are everywhere most deficient in amount. The men suffer much from ennui. For all practical purposes they are entirely idle; and they complain of what they feel everywhere, the "weary idleness" of their lives, and that there has been so little done in the way of giving them occupation. 1464, 1465. 479. 4470.

The want of exercise, and a coincident high rate of sickness and mortality, falls most heavily on the infantry. The cavalry regiments and artillery, who have, one way or other, much more physical exertion to undergo, are much more healthy.

From every station there are requirements for increased means of occupation, which we shall briefly notice in detail.

Foremost amongst the proposals is that for—

Workshops.

Workshops.

At most of the stations there are none at present; while it is admitted that everywhere they would be most useful. The only difference of opinion is as to the kind of work to be done, and how the workshops and tools are to be provided. All agree however, that the trades should be useful, and that the soldiers should make money by them. The opinion at some stations is that the work done should be of such a kind as is required by natives, and should be sold to them. Colonel Campbell suggests cabinet-making, shoe-making especially, and printing. 5102. *Vide* Stational Reports. 4122, 1479.

He states that he used to print all his own returns in this way, as well as papers for the civil authorities at Lucknow, and that at Meerut he was able to supply 100 pairs of boots to the 81st regiment, who could not otherwise have obtained them. 4130 4134.

Sir J. Lawrence proposes that the men should make "any-thing connected with their regiment," such as clothes, shoes, iron-work, &c. 2955.

As regards tools it is considered that Government should provide them in the first instance, and that they should be afterwards kept up by the regiment. It is satisfactory to know that every barrack in the Punjab has a workshop attached to it, and that the subject has already attracted considerable attention on the part of the Indian Government.

Sir Proby Cautley puts in three letters from soldiers themselves, in proof of the advantage of occupying their spare time. 3960. Addenda, 1, 2, 3, p. 239, *post*.

And the experience of the 3rd Bombay Fusiliers, extending over seven years, affords remarkable instances of improvement in the men's moral character from indoor occupations. Courts-martial and crimes diminished in proportion as the men were occupied for their own benefit. It has indeed been the opinion of some of the greatest army surgeons that the soldier should be permitted to do for himself whatever he can do, without injury to his health or discipline. 74.

It has been proposed by Sir Alexander Tulloch and Colonel Durand to extend the soldier's occupation beyond the workshops,

Workshops.

5650, 5102.

5110

and to make him useful in outdoor work, such as in building barracks, or in magazines, or even in farm work; but the objection to such proposals is that, in a country where labour is so cheap, it would cost much more to have it done by the soldier than by the native worker. The gain would be in the health, comfort, and contentment of the men.

Addendum to evidence, p. 269, *post.*

Sir C. Trevelyan has also stated that soldiers would not come forward for public works, unless they were entirely excused from military duty for the time.

In the present state of the question, we propose that the existing means for carrying on indoor trades should be extended, or provided where they do not exist, under such regulations as would make it, as far as practicable, the interest of the men to occupy themselves profitably.

5357.

Sir Charles Trevelyan has laid before us an important suggestion for improving the soldier's condition, by holding out to him the prospect of bettering himself by his own exertions and good conduct. He proposes to select from regiments men of good character, trustworthy, with competent knowledge of reading, writing, and arithmetic, and an elementary knowledge of native languages, such as may now be obtained in schools; to submit these men to some suitable test, and then to train them for subordinate offices in the administrative departments. He states the plan to have been adopted successfully at Madras, and it is in our opinion well worthy of further consideration. It is, however, liable to the objection that it withdraws from the army the most trustworthy men, and thus tends to limit the supply of competent non-commissioned officers.

Soldiers' Gardens.

Gardens.

Stational Reports. 966–7.

2952.

5554

Attempts have been made to establish soldiers' gardens at several stations, chiefly with the view of occupying the men and providing vegetables. They have been mainly connected with regiments, an arrangement which no doubt has militated against their success. At some stations they have been very useful, and the men have taken great pleasure in them. At other stations they have not been so successful, apparently from the reason mentioned. The regiment may be called away at any time, irrespective of the state of the crop, so that the men may lose the result of their labour. But Sir A. Tulloch is of opinion that, if the gardens were attached to the station, and if an arrangement could be made by which the men were paid for their work, the gardens would succeed; for the men, he says, are fond of gardening, and a very great proportion of them, after they are pensioned, become successful cultivators.

We are of opinion that every encouragement should be given to these gardens. They have often succeeded in other services, and are worthy of a fair trial in India; and an arrangement could easily be made by which the interests of the outgoing regiment could be protected. There is a proposal from one station to establish farms.

Gymnastics.

Gymnastics. Stational Reports.

It is scarcely necessary to advocate the introduction of gymnastic exercises. They have been extensively used in foreign armies, and a beginning has recently been made at home stations, and also at one or two foreign stations; but up to the present time there are no gymnasia in India, although the evidence from the stations proves that it would be most advantageous to provide them.

3220–3224.

The evidence given before us shows that gymnastics would be "the best thing ever introduced into the service in India," provided they were made "a parade," and the soldiers "dressed "loosely" for the purpose.

The gymnasia should of course be covered, and provided with the usual fittings. According to the new medical regulations, the medical officer is required to see that the exercises are conducted in such a manner as not to be injurious to health; so that nothing further will be necessary than to provide the accommodation requisite.

1013, 4135, 5247, 3229.

The gymnastic sheds, if made sufficiently large, would afford another kind of accommodation very much required in India, viz., covered places where the men could walk and take exercise during the heat of the day, and in the rainy season apart from the barrack rooms, where they are at present literally confined at these times.

On this subject of exercise, another most important question presents itself; viz., whether it is really necessary to confine the soldier so rigidly to his barracks during the heat of the day. The assumption seems to be that if allowed to go out he will expose himself and get sun-stroke or some other disease, and so the health of the regiment would suffer. No evidence of this result has been adduced before us; and indeed it would, at first sight, appear doubtful whether confining a number of men all day in the same crowded room where they eat and sleep, in a state of absolute inaction, is not, in such a climate, productive of more injury than allowing the men legitimate liberty. The very idea of confinement is in itself injurious, and is very likely indeed to make the soldier miserable. Tell him, however, that he may go out, and, at all events, the idea of unnecessary restriction will be removed. We have evidence before us of men being allowed to go out shooting by their commanding officer in the hot season; and they were all the better for it. At all events they did not suffer in consequence. It is stated that the men liked shooting better than any other amusement: that the effect on their health and spirits is good: that the liberty given has never been, in any single instance, abused; and that it was quite a point of honour with them to behave well.

3228.

1404.

3206–7.

3208.

At malarious stations, and during dangerous seasons, the same amount of liberty cannot, of course, be given with safety.

3227.

But Colonel Greathed has cited a remarkable instance of the

GYMNASTICS. benefit derived from this liberty in one of the hottest stations in India.

3203. In the hottest station, Deesa, where we were for three years, the mortality in the regiment was extremely small, and the general health of the men was excessively good. I mean to say that they were able to take the most active exercise there without suffering from the heat. We allowed them to go out shooting as much as they liked all over the country, and a man would go and walk 14 miles on foot from the barrack, and be back at night; their health and spirits were excellent, and there never was a single case of a difference between the soldiers and the natives in the whole of the three years during which time we gave them unbounded liberty; I mean, of course, to the good men.

In this, as in every other matter bearing on the soldier's health, no precise rule can be laid down. The present evil is, that there *is* a precise rule, viz., to confine the soldiers to barracks; while the nature of the case and the evidence both indicate, that the men should, on the contrary, have every facility given them for exercise, under such local restrictions as common sense points out.

LIBRARIES AND READING ROOMS.

LIBRARIES, &c. At every station there is a library of some sort; but these libraries resemble closely the libraries at home stations. They are not a whit more comfortable, in general, with a few exceptions, not so well lighted. This last defect they have in common with all the barrack rooms; for in India "deficiency of light" is a "universal fault." The supply of books is bad, and a "constant "influx of new works" of light literature is as much required as in England. There are very few proper reading rooms, fewer still of day rooms. There are no means of getting refreshment, such as tea, coffee, &c., connected with any of these rooms; although it is obviously most desirable to extend this class of accommodation to India, as is now being done at home stations. The men in India are in more need than they would be at home of some place out of their bed rooms, where they can smoke, talk, and have harmless refreshment, without being exposed to the temptation of canteens.

Stational Reports.

4123.

4119.

3219. The men are always willing to take advantage of any rational means of recreation; and we have on evidence a very satisfactory instance of a successful coffee room, given by Brigadier-General Russell. It was supported by voluntary contributions from officers and men. The library contained 1,000 volumes, and received a quarterly supply of books, newspapers, and periodicals from London. In the coffee room the men could have ginger beer, soda water, tea and coffee, biscuits, preserves, &c. It was at a distance from the canteen, expressly to keep the men out of the way of temptation; "the very smell of the liquor being a temptation." All amusements near the canteen were discouraged, and only encouraged near the coffee room.

3777–3779.

This is very much what is to be carried out at home. And having succeeded at one station in India, it ought to succeed at all with similar care.

Much improvement is required in lighting barracks and reading rooms in the long evenings. Small oil lamps, such as are at present used, give a very inefficient light. Wherever gas can be obtained it should be introduced at the Indian stations, as has been done at home. But there are very many stations in India where gas is not available, and it is worthy of consideration whether at these stations gas apparatus should not be provided. Of late years great improvements have been introduced in the manufacture of gas for single establishments by means of simple portable apparatus, which might be tried in India. Coal is not everywhere to be had, but there is at all barracks a certain amount of refuse matter which might be used for the purpose. Lieut.-Colonel Ouchterlony has directed our attention particularly to the importance of the subject as regards the comfort of Indian barracks, and he shows that it would be economical even to convert the present allowance of oil into oil gas instead of burning it imperfectly in the defective lamps in use. We concur entirely in the importance of these suggestions for the comfort of the soldier.

Libraries, &c.
4124.
Page 491, *post.*

Theatres.

There are theatres at many stations, generally in large unoccupied barrack rooms; and sometimes there are rooms erected on purpose, which are also used for music, lectures, glee-singing, dancing, &c. The theatre is a great source of amusement, and occupies many men who have no other interest. To the actual performers it is "rather lucrative."

Theatres.
3778.
Stational Reports.

Hospitals.

The European hospitals are constructed on the same general plan as the barracks at the station. The soils, sub-soils, and means of external ventilation are of the same character, except that the hospitals are more isolated than the barrack buildings. The materials and construction are the same. The wards are on the ground floor, elevated at most a foot or two above the level, but without any passage of air beneath the floor. The better class of hospitals are those which consist of detached wards, with a single verandah, because they admit of easier ventilation. The worst are those which have a number of wards in the same building, or double aisles with more than two rows of beds between the opposite doors and windows.

Hospitals.
Abstract of Stational Reports, *passim.*
Also pp. 324–30, *post.*

Although more constant care is exercised over the general sanitary state of hospitals than over that of barracks, it cannot be said that the great majority of them are well adapted for the treatment of sick.

The plans bear evidence of not having been subjected to any intelligent medical or sanitary revision; and they carry out the description of Sir R. Martin, that the buildings are generally defective, and the latrines and drains generally deficient.

175, 176.

The wards vary to an extraordinary degree in their dimensions and number of beds. Besides the usual "small wards" containing

Abstracts of Stational Reports.

Hospitals.

one or two beds, the numbers vary from 16 beds per ward, as in Fort St. George, to 20, 30, 40, 166, 100, as at Dumdum and Kurrachee, 150, as at Dinapore, while at Trimulgherry (Secunderabad) there are two wards for 228 beds each.

The dimensions of course vary. The smallest class of wards are about 25 feet in length, and from that to 60, 70, 120, to 140, 334 feet, as at Dumdum, 349, as at Poona; and perhaps the longest hospital ward in existence is at Dinapore, no less than 633 feet in length. This ward is 21 feet wide and 18 feet high, being, in fact nothing but a very long narrow passage, like the Scutari corridors, memorable in history for their immense fatality to the sick in them, owing in part to this long narrow construction.

The usual width of Indian hospital wards is from 20 to 25 feet, with windows and doors on opposite sides.

In a few they are 40 feet wide; at least 10 feet more than they ought to be for health.

The wards generally are of considerable and unnecessary height; 18 feet is a common height, as at Poona and Kurrachee. The height is, however, often from 20 to 30 feet, and even 42 feet, as at Trimulgherry. The question of height is a very important one as indicating the extent of surface over-crowding; for, as in the barracks, excessive height crowds the hospital even with an apparently large cubic space per bed. At Trimulgherry, *e.g.*, where the cubic space per bed is 1,000 feet, the superficial area is in some instances as small as 24 feet, and varies to 45 and 75. At Poona the beds have 1,300 cubic feet, but only 70 and 72 square feet. At Dinapore they have 1,000 and 1,500 cubic feet, but only from 52 to 88 square feet. At Dumdum, with 1,500 cubic feet, the superficial area is 78 feet. There are wards with from 1,800 to 2,000 cubic feet, in which the superficial area per bed is from 76 to 84 feet. In some better proportioned wards, 1,400 cubic feet give above 100 square feet. The largest superficial area given in any Indian hospital is at Deesa, in which the ward proportions are such that, with 2,000 cubic feet, they afford 114 square feet per bed.

The usual cubic space per bed is from 1,000 to 1,200 feet, rising occasionally to 1,500 and 1,800, and in certain exceptional cases to 1,900 and 2,000. There are hospitals, however, in which the amount falls far short of this. There is a ward at Surat which gives only 760. Above two thirds of the sick at Fort William have 927 to 977 cubic feet each. There are a number of wards in which the space varies from 660 to 960 feet. The smallest amount is at Ahmedabad, where it is between 456 and 1,050 feet. The superficial area in the great majority of cases is between 50 and 80 feet per bed. And hence in that element which is of the most importance in an unhealthy climate, viz., surface over-crowding, the hospitals as well as the barracks must be condemned.

It would be very advisable to reduce this great diversity in practice to one common rule, applying the rule to suit local circumstances.

HOSPITALS.

The Royal Commission on the Sanitary State of the Army recommends, for the comparatively small stations in warm climates occupied by Her Majesty's troops, an allotment of 1,500 cubic feet per bed. The Indian stations vary so much in their topographical position and local climates, that it would be better to fix a minimum and maximum space between which the allotment at each station should be made. In all the more elevated, better ventilated, and healthier stations, we suggest the minimum of 1,500 cubic feet; and in all the low-lying, damp, and less healthy positions a larger space and superficial area are required. The beds should be arranged along the walls, with not less than 8 feet of wall space per bed in any case, and with the larger amount of cubic space, more wall space should be given. The superficial area per bed should never be less than 100 square feet with 1,500 cubic feet, and from 130 to 140 square feet with 2,000 cubic feet per bed.

VENTILATION OF HOSPITALS.

HOSPITAL VENTILATION.

The ventilation of hospitals is effected by opposite doors and windows, aided in many cases by a ventilator in the roof. The evidence before us shows that it varies very much in efficiency. From Sir R. Martin's experience it appears that there is a want of strict attention to ventilation. The old European hospitals are very badly ventilated, while the newer ones are described as very good indeed. The atmosphere in the older hospitals is often very bad and impure from over-crowding.

Stational Reports. 165.

1585, 1589. 1590.

All that has been said with reference to the draughts produced in barracks, applies with greater force to hospitals. As the ventilation is principally by the doors, and as there is insufficient control over it, it is very often extremely uncomfortable, especially to men with rheumatism, chronic dysentery, &c. in the cold months.

692.

Some hospitals are complained of as being dark, and wherever this is the case they must be close too. In one instance, at Meerut, there is so little light that operations have actually to be performed in the verandah outside. In some instances there appears to be no well-lighted room in which surgical operations can be performed.

724, 725.

Dark hospitals are unsuitable for sick.

A sufficiency of light is as necessary as a sufficiency of fresh air; and it is quite possible to supply both without too much sunlight or too many draughts.

What we have said respecting the ventilation of barracks applies to hospitals. It should be provided for along the ridge and under the eaves; and the patients should on no account be exposed to draughts, either from doors or windows.

Unless the wards be raised a sufficient distance from the ground, it is impossible to supply them with fresh air. As at present constructed, malaria from the ground must necessarily permeate the whole building. The only way to avoid this evil as far as

Hospital Ventilation.

practicable, is to construct hospitals always of two floors, placing the sick only on the upper floor, and providing for a free ventilation between the ward and the ground.

Hospital Ablution and Bath Accommodation.

Hospital Ablution.

Stational Reports.

The ablution and bath accommodation consists occasionally of a "tin pot" with which "the sick generally pour the water over "themselves," as at Bombay. Very frequently there is no ablution room, and the patients wash themselves if at all in the open verandahs in all weathers. Generally there are no basin-stands: and the sick have often to sit on the ground to wash their faces. The only bathing is done in wooden tubs, to which water is carried by bheesties; and it is usually poured over the patients. There are no warm baths, and indeed no baths at all in the sense in which they are understood in all the hospitals of Europe, and even in the military hospitals at home. The means of cleanliness for sick as sick, are, to sum them up, *nil*.

3508.

Every sick ward should have its basin stand with fixed basins, and a bath, both with hot and cold water constantly laid on, in a separate small room attached.

Hospital Drainage.—Water-closets.

Hospital Drainage.

Stational Reports.

Hospitals are no more drained than the barracks to which they belong. There is surface drainage; but the roof water is allowed to sink into the ground. There is no subsoil drainage; and all fluid refuse has to be removed either by hand, or, by escaping as it best may, to remove itself. No hospital can long continue healthy under such circumstances. All hospitals must be drained together with the barracks to which they belong.

There are no water-closets in any hospital in India. The usual arrangement is to have night-chairs placed in a small room adjacent to the ward, or to have privies at a distance of from 30 to 80 feet, connected with the hospital (by a covered way), and of the same construction as the barrack privies, often placed over cesspits cleansed once a day, and sometimes provided with pans which are removed daily. The arrangements are those of a camp hospital, and have long since been condemned in Europe.

Every ward should have a water-closet, if practicable, with one or two seats according to its size, having a separate ventilation. It is the only healthy arrangement for sick; every other is liable to danger, especially in the event of cholera or dysentery prevailing, as nothing but immediate removal can prevent the risk of dangerous emanations. In stations where from the want of water no water-closets can be provided, provision for such immediate removal ought to be made.

Diet Tables and Cook-houses.

Hospital Diet.

The diet tables now in use in the Indian army are similar to those formerly in use in the British army. They lay down a certain number of fixed diets for every day use, to which the

Hospital Diet.

medical officer may add extra articles at his discretion. This practice was attended with many disadvantages in Queen's regiments, to avoid which, a new scale of diets containing sufficient variety for all hospital purposes, and rendering extra articles unnecessary, was made matter of regulation. For the sake of uniformity, the new diet table should be adopted for all regimental and general hospitals in India, so far as the supplies will admit of it.

Stational Reports.

Hospital cook-houses are similar to barrack ones: they are in small detached buildings, and are provided with the usual small fire-places and utensils. There is not sufficient variety in the cooking, and sometimes it is complained of as being bad. The cooks are chiefly natives, and have no training in the specialties of hospital cooking; or they are equally untrained men taken from the ranks and liable to be withdrawn at any time. On home stations arrangements are in progress to supply every hospital with a trained cook from the purveyor's branch of the army hospital corps. The cook will be responsible to the head of his department for the state of the hospital cooking; and any cause of complaint will be removable. It would be very desirable that some such responsible system should be extended to hospitals for Her Majesty's troops, while serving in India.

Hospital Bedding.

Hospital Bedding.

Hospital bedsteads are generally of wood, sometimes of iron. Wooden bedsteads are at all times, but especially in warm climates, subject to vermin; and complaint is made of the expense incurred by the men breaking the bedsteads in their efforts to get the vermin out. The bedding is of mattresses and pillows stuffed with a variety of materials, chiefly straw and country hemp. By far the best form of bedstead is the iron hospital bedstead in use at home; it should be supplied at all Indian stations. The best material for hospital bedding is hair, now supplied by regulation for mattresses, bolsters, and pillows, in all hospitals of the British army.

Stational Reports.

Hospital Attendance.

Hospital Attendance.

Attendance on the sick is mainly provided for by a surbordinate medical department, with native assistants. The number is fixed by regulation; but the numbers actually employed appear to differ at different stations. They consist of apothecaries, steward, apprentices, dressers, cooks, washermen, water-carriers, tailors, barber, ward coolies, nurses, bearers, sweepers, &c.

Stational Reports.

The regular establishment for an European corps contains 79 of these officials. In the hot season there are added 34 water-carriers, 23 coolies for throwing water on tatties, 104 coolies for moving the punkahs, making the total establishment 240.

Besides these, there is the regimental hospital serjeant, and orderlies taken from the regiment, who are supplied in all serious cases or at the request of the sick.

Hospital Attendance.

So far as numbers are concerned, the supply of attendants is no doubt on the most liberal scale, when contrasted with that which is found in practice to be sufficient for regimental hospital service at home.

Generally we may consider that wherever "a comrade can be "told off from the ranks" to attend "upon any case which desires "it," there can be no discipline, nothing which can be called efficient nursing of the sick, in such a hospital.

The hospital establishment for a battalion of infantry at home, according to the recent warrant, consists of 1 serjeant for discipline and for attendance on the sick, with 5 privates; also 1 serjeant, with 2 or 3 privates, belonging to the purveyor's department, for providing the supplies, cooking, and care of stores.

The regular establishment of a battalion at home would therefore consist, of 2 serjeants and 7 or 8 privates, while in India the same battalion would have a regular establishment of 79, capable of being extended to 240 in hot weather.

The hospital serjeant receives 1*s.* per day additional pay for compounding, if he qualifies himself for that office; and the cost of a compounder is saved. In India the dispensing is done by six officers of the subordinate medical establishment.

Even in temperate climates, and in civilized countries, where the water is brought to the door, the laying on hot and cold water all over a hospital and the use of lifts, makes the difference of one attendant to every 30 patients. While the most objectionable system of water-carrying, instead of water-laying-on, lasts in India, where not only has every drop of water to be carried to the hospital before it can be carried over it, but to be carried away again when foul, the cost of this kind of arrangement cannot be far short of two-thirds of the whole; and the expense of a civilized system of water-supply and of drainage may prove to be actually less than keeping up this enormous staff.

Miss Nightingale's paper, p. 329, *post.*

As regards the quality of attendance, there can be no doubt that natives, however kind they may be, if untrained, are not the class of attendants the sick want. The same applies to "comrades from "the ranks." The hospital corps men at home under the new warrant, are, it is true, taken from the ranks; but when they are trained they cannot be returned to the ranks, except for misconduct or inefficiency.

As in future each battalion will carry with it its quota to India, it is worthy of consideration whether the Indian hospital system might not be revised with advantage and economy.

The stational returns contain a great number of complaints as to the untrained character of the hospital nursing.

The hospital establishments throughout India are generally regimental. There are very few general hospitals. The superior advantages of these for the sick, as regards their care and comfort, are admitted; and several are being organized at home and on foreign stations, in terms of the new medical regulations. Female nurses have already been introduced into one of these; and the system is to be extended to others. The only instance of the kind

in India appears to be the general depôt hospital at Allahabad, consisting of 400 beds. Six European nurses have been attached to this hospital since 1858, and are stated to be a great comfort to the sick.

Hospital Attendance.

Vide Allahabad Stational Report, page 365, *post.*

Female nurses are not suited to, nor are they used for regimental hospitals; but wherever, on large stations, general hospitals are organized, they should be introduced; and in these, as well as in the instance of Allahabad, the nursing should be organized according to the regulations in use for Her Majesty's service. Miss Nightingale, in her observations, has made some excellent remarks on the present state of Indian military hospitals, and on their want of adaptation for the care and speedy recovery of sick. She considers them rather as being like camp hospitals than as establishments adapted for permanent barracks or stations, and consequently deficient in many of the most important requisites for efficient nursing and treatment. She points out many defects which might be remedied, and considers the hospital arrangements generally as of a makeshift character, requiring great improvement to make them at all comparable with those of the recently improved military hospitals at home.

From the evidence it appears that every station for British troops in India has one or more female hospitals for the sick of soldiers' families, generally under the same management as the regimental hospitals at the station, and that they are in most cases supplied with matrons, native nurses, and midwives. The attendance and nursing is generally considered sufficient, but the buildings not so in all cases.

We have now completed our analysis of the information laid before us regarding the various influences affecting the soldier's health and efficiency in India. In weighing the evidence, especially that referring to the sanitary condition of stations, it is impossible to evade the conclusion that a great part of the sickness and premature mortality in the Indian army is due to preventable causes. In times past climate has been popularly blamed for results which would follow in their degree similar causes anywhere. Our inquiry has shown that the causes must be sought in defective sanitary condition and in bad habits, and it is in the correction of these that we must look for diminished mortality and increased efficiency. In the words of Miss Nightingale, "it would require very strong "evidence indeed to convince the people of this country that the "epidemics which have devastated India arise from any other "causes than those which the stational returns and the evidence "prove to exist in what one may call a state of absolute perfection "in the Indian towns, but which have been removed with entire "success in this country."

Observations, page 339, *post.*

Hill Stations.

Hill Stations.

For some years past the conviction has been gaining ground in India that, in order to diminish the high rate of sickness and mortality, it will be necessary to remove a considerable proportion of

HILL STATIONS.

the troops from low malarious plains and river-banks, and to station them on high table-lands or isolated mountains. It has been assumed that by simply removing the troops from the influence of heat, moisture, and malaria, which conjointly are admitted to sap the constitution and predispose the men to disease, troops would be kept in a state of efficiency similar to that of colder climates. This proposition has two aspects; 1, as regards health; 2, as regards the military occupation of the country; and we must consider it with reference to both of these, in order to estimate its exact value, and the extent to which it can be carried into effect.

So far as health is concerned, the evidence in the stational reports is, with a trifling exception, decidedly in favour of mountain climates, especially during the earlier years of service; and the evidence of witnesses tends to the same result. Hitherto, however, there has been no experience on any large scale of the sanitary influence of hill climates on healthy troops. For it has been the practice to send to the hills men either absolutely diseased or convalescing from severe diseases, or sickly regiments; and, so far as these classes are concerned, hill climates have been found beneficial in certain descriptions of cases only, but in all others either of doubtful efficacy or positively injurious.

215. We are indebted to Sir Ranald Martin for having brought this subject prominently before us, and also for having directed the attention of the Indian Government to its importance. The *primâ facie* evidence derived from the superior healthiness of the inhabitants of elevated plains and mountain regions generally, would alone warrant a careful local inquiry into the adaptation of such Indian climates to European constitutions. But, besides this, a large amount of experience has already been obtained in the case of civilians and military officers, who for many years past have been in the habit of resorting to the hills, in order to recover from the exhaustion produced by service on the plains.

3047, 3050. Similar evidence is afforded by the Lawrence asylums, one of which, containing 500 children, is at Sunnawur, and the other at Mount Aboo. Children are taken in at four or five years; and during their residence they look like English children, while those in the plains below are "pale, pasty, and wasted."

4501. There is a convent at Darjeeling, with 11 adults and 28 children sent up from the plains; during 13 years there had been no death among the children, while the mortality among the children in Bengal is 84 per 1,000 per annum.

As, of all subjects, children are the most susceptible to sanitary defects of any kind, this experience proves that these hill stations are not necessarily unhealthy, and that, if found so for grown men in health, the cause lies elsewhere than in the climate.

It may fairly be taken for granted, that properly selected hill stations, under proper sanitary management, would be of great advantage to the health of the army; and we propose, therefore, to confine our attention chiefly to those points in the selection

270. which have been brought before us in evidence. Indeed, Sir Ranald Martin, while strongly advocating the adoption of hill

stations, states that the whole subject has to be investigated *ab initio*, both as regards "the mountain ranges" and "the climates "most suited to the occupation of European troops." Hill Stations.

The stations which have hitherto been selected as hill sanitaria are of two classes; those on the spurs of the Himalayas, chiefly occupying elevated and narrow mountain crests, and those on the table-lands of southern India. There is another class, of which there are only one or two examples, viz., isolated mountains, such as Mount Aboo and Ramandroog. The least elevated of the Himalaya stations is Subathoo, 4,000 feet above the level of the sea, and the highest are Darjeeling and Simla, 8,000 feet above the sea. The southern Indian stations vary from 5,000 to upwards of 7,000 feet in height. Mount Aboo has an elevation of upwards of 4,000 feet, and Ramandroog of 3,400 feet.

The majority of the stations being on the outer face of the mountain ranges, and at an elevation where the heaviest rains occur, receive the first impact of the monsoon; and the consequence is that they are all wet, and subject to cold fogs. The annual rain-fall in the Himalaya stations varies from 70 inches to 132 inches, as at Darjeeling. The rain-fall at Mahableshwur, in Bombay, is actually 240 inches per annum. In the Neilgherry group, which are not exposed to the monsoon, the rain-fall is from 50 to 60 inches a year. The mean temperature varies, of course, with the latitude and elevation. In the Himalaya group, the highest mean is from 64° to 78°; in the Neilgherries, from 63° to 70°. The lowest mean in the Himalayas is from 35° to 42°; the lowest in the Neilgherries is from 53° to 60°.

The great objection to the Himalaya group is that already stated, viz, the damp climate and excessive rain-fall, the only way of avoiding which would be to select stations at a lower elevation, or more in the heart of the mountains. In this way the force of 140.
the monsoon would be avoided; but, on the other hand, the difficulty and cost of transit, and the long distance to be traversed by 2372.
troops in descending to the plains, present serious obstacles.

The present stations are described as having clouds continually 1113.
hanging about them, dispersing and reforming very quickly; at one moment in sunshine, with inconvenient warmth; at another, in cloud, with considerable chill.

An elevation of from 6,000 to 8,000 feet is also prejudicial, Stational Reports.
because, although malaria is to a great extent absent at such a height, troops proceeding from the hot moist plains, where the function of perspiration has been so active, are suddenly exposed to lower temperature, to cold damp air; the result of which is that they become liable to other diseases, chiefly of the bowels and chest.

The diseases of a colder climate are substituted for those of a warmer one. Much has depended on want of care in moving the men: no sufficient attention has been paid to change of clothing, diet, or exercise. The men have been usually left to wander down into the ravines and valleys, filled with jungle, where the sun is

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intensely hot; and, as we shall presently show, the sanitary condition of the stations has been much neglected.

We have the mortality returns for hill stations for a few years only, and they throw but imperfect light on their influence on health.

The mortality at Murree, 7,000 feet above the level of the sea, was for five years at the rate of 92 in 1,000. It was an invalid depôt, and several sick men died there, who had been attacked at other stations. Of 39 deaths in Murree, 12 were by dysentery; of 964 attacks, 644 were by zymotic diseases.

3035. These elevated regions are not even exempt from epidemics, of which a remarkable illustration occurred at Murree. Sir John Lawrence informs us that he saw cholera raging there "in a mag-

4520. "nificent climate, a beautiful site and fine barracks, and there was "nobody else sick but the soldiers." Out of 254 men in barracks, 42 were attacked, and 31 died, of cholera. Not one officer suffered, a clear proof that the men were exposed to some specially unfavourable condition.

The important military position in front of Simla is occupied by Kussowlie, Subathoo, and Dugshai, at which regiments or detachments have been stationed for some years. The mortality at Kussowlie (440 men, 8 years) was at the rate of 37 in 1,000; at Dugshai (717 men, 6 years) 36; at Subathoo (209 men, 3 years) 68 in 1,000. The excess of the mortality was chiefly due to dysentery, diarrhœa, apoplexy, hepatitis, fever; and upon subtracting zymotic diseases, the mortality is reduced to the same rate as prevails in the districts of the higher plains in India. In Subathoo the mortality was at the rate of 15, in Dugshai of 28 per 1,000 in 1860.

Nynee Tâl near Almorah, 7,609 feet above the sea, is now occupied by a regiment, but supplies no returns. Landour (7,000 feet) is a small invalid and sanitary depôt; the mortality was, for 10 years, after excluding the invalids, at the rate of 61 in 1,000. Of 67 deaths, 17 were by dysentery. Darjeeling, in Sikkim, is the hill station nearest to Calcutta. It was a convalescent depôt; and for 9 years the mortality was at the rate of 39 in 1,000. Of 25 deaths 8 were by dysentery.

It must be borne in mind that all the Himalayan hill stations are of comparatively recent formation, and that the mortality is in every case augmented by the deaths of men who were attacked at other stations. The supply of fruit and vegetables is often defective. The water is sometimes polluted, and the men suffer from descending into the close ravines.

Stational Reports. 1109, 1560. Notwithstanding these objections, merely local, the evidence is in favour of carefully selected positions on ridges or mountain ranges, as being decidedly advantageous to European health, although experience has proved that they are so only within certain limits.

2963. Sir J. Lawrence, while admitting that men would be healthier on hills than on plains, states that there are constitutions which

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do not benefit by hill residence. And Colonel Greathed states that, though the men look better on the hills, the returns show no great difference as regards health; but he admits, at the same time, that the sanitary condition of the stations was very bad. 3261.

This last point is one of primary importance, for it is clear that, if hill stations are supplied with bad barracks and hospitals, deficient water-supply, no drainage, and if the vicinity is allowed to become a reservoir of filth, troops leaving the plains for the hills will leave behind them malaria, to find in its stead foul air (and perhaps more intensely foul air) from other causes.

The stations being generally on ridges and near ravines, afford great facilities for perpetrating all kinds of nuisance. There is a large native population, over whom very little sanitary inspection is exercised. At Simla, the "conservancy" is described as having been as bad as could be, the ravines full of dead animals, together with the ordure of many thousand natives. There are no public conveniences. The water supply was scanty, and liable to pollution. The effluvia from the ravines were "as strong as on going "into a sewer." A large amount of hill diarrhœa prevailed among the residents, which Surgeon Major Grant attributed mainly to want of sanitary precautions, and neither to the elevation nor to the damp atmosphere. He states that the disease had gradually increased with the increase of population, and that "the authorities "seemed to think that, because the climate was cold, the men "might be crowded together, and all sanitary arrangements neg-"lected with impunity." The men were crowded together at Kussowlie with fatal results. Colonel Greathed informs us that, when the rains begin, the nuisance produced by the washing down of the filth is intolerable. 4484, 4487. 4486, 4487, 4492. 3267.

The reports on the stations give the evidence of a number of officers on this same subject. We learn from them that the barracks at several stations in the Simla group, such as Subathoo and Kussowlie, are bad in structure and plan; that at Mount Aboo the barracks are erected in a malarious gully; that at Nynee Tâl, 7,600 feet above the sea, the huts have been built in a narrow defile, where the earth is damp, and a perfect marsh during rains, and where the huts are exposed to violent gusts of wind. The bazaars are filthy and crowded. There are neither drains nor latrines, and "the stench is at times overpowering," causing nuisance in the barracks. At Darjeeling the medical officer reports the sanitary condition of the hospital for convalescents as "bad," and he states that he had been making representations for five years as to a privy under a verandah connected with the hospital, before he could get the nuisance abated, which rendered the ward so offensive that the sick had to be moved out of it. The drainage is defective, and "the inducements for the sick to remain dirty "are," he thinks, "greater than those to be clean." *Vide* Abstracts and Stational Reports.

The hill stations on the Neilgherries are not exposed to the same objection as regards climate; the rain-fall is much less, and the air is drier; there are fewer fogs, and altogether this group of stations is perhaps the best yet occupied. But even here the usual fatality

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followed neglect of very obvious sanitary measures. When the station at Jackatalla, now called Wellington, was first occupied, much disappointment was experienced on account of the high rate of sickness and mortality.

The mortality of the 74th Highlanders, during three years at Jackatalla, was at the rate of 39 per 1,000. Of the 68 deaths in the regiment, 19 deaths were by dysentery, 6 by diarrhœa, 8 by cholera, 6 by apoplexy, 9 by hepatitis. The barrack square "was "frequently an immense swamp." In 1860 the mortality of the 60th Rifles, third battalion, was at the rate of 24 in 1,000 at Jackatalla; the mortality of the 66th Foot at Cannanore was 11 in 1,000 during the same year. Cannanore is on the coast, and 20 feet above the sea level.

On inquiry into the causes of this sickness, it was discovered that, besides want of attention to drainage, the large body of from 2,000 to 3,000 workmen employed on the buildings had been under no sanitary control, so that the ground for miles about was "one immense privy," and the troops suffered to a great extent
2336. from bowel disease in consequence; but since sanitary arrangements were thoroughly carried out, the sickness has been under one per cent. of the strength.

One thing is quite clear, that it will never do to trust simply to elevation above the plains to keep the army in health.

4258. Malaria has been blown up ravines in India far above the fever range, over sites otherwise perfectly healthy; and those who slept within its influence have been attacked with fever and died.

We have shown that epidemic disease originates at hill stations just as it would do at unhealthy stations at home. Hence, in selecting sites on hills, all the precautions necessary for selecting sites on plains are just as necessary. The climate, exposure, subsoils, drainage, water-supply, local diseases, and the relation to distant sources of malaria, require careful examination; and all buildings, whether for European troops or natives, must be subjected to the sanitary conditions as to structure and supervision which are everywhere required.

It is always desirable, as suggested by several witnesses, to test new hill stations by a residence at them of a certain number of Europeans and natives, before they are occupied. The preponderance of evidence is rather in favour of heights of moderate elevation than of those so high as Darjeeling. Sir R. Martin states that the best elevations have yet to be determined, and that probably heights of from 2,000 to 4,000 feet, if otherwise suitable, would be best in practice.

We are of the same opinion, and would suggest that stations of intermediate height should be carefully sought for, and their sanitary relations investigated.

3051. It is objected to stations on narrow mountain ridges that there is not sufficient space for healthy exercise; that the men can scarcely leave the immediate vicinity, and suffer from confinement. The men complain of their forced inaction, and dislike these
1143, 6, 7. stations. But this admits of remedy. Sites very defective in this

respect should not be chosen, or, if already chosen, it is always possible to find space for gardens by terracing the slopes; and occupation may be given to the men in this way. Abundant means of exercise are indispensable to health on the hills.

The men find the hill stations dull also, it is to be feared from their being cut off from the debauchery and excitement of the plains. But on the other hand, this isolation from the plains is considered to be a great advantage as regards health, by enabling a more strict police to be exercised, whereby the sources of debauchery are cut off. 1144, 5324.

We next proceed to consider the extent to which hill stations can be occupied consistently with military and political considerations. There is some diversity of opinion on this point, as there is also on the precise manner in which hill stations should be used. On one point, however, all are agreed, viz., that sickly regiments should not be sent to the hills; for such regiments invariably suffer in health.

As regards disease, the mountains of India are but partially curative. 147.

There is also a general concurrence of opinion that healthy regiments, or parts of regiments, should be stationed on the hills, and that men who are beginning to suffer in health from service on the plains should be sent to the hills. Of this latter class there is a considerable proportion in all regiments. If left in the plains, many of these would become subjects of actual disease; and from the nature of the case they should be sent to the hills for restoration to health. As regards the others, it has been proposed to locate most of the effective force on hill stations, at such a distance from the plains as would enable them, either by roads or railroads, to be thrown on any point where their services might be required.

But it is very soundly objected to this by Colonel Durand, that any large proportion of the troops cannot be permanently quartered on the hills without detriment to the military occupation of the country; that to do so would be practically to evacuate the country; that it would be most dangerous not to occupy the great strategical points, upon which the security of the country depends; that there are many posts which must be held, healthy or unhealthy. Several illustrations of these dangers occurred during the mutiny, where important points were lost from deficiency of force before regiments could be brought down from the hills. It is clear that all necessary points in the plains must be held by a sufficient force; and hence whatever proportion of troops is placed on the hills, must be considered as "a reserve." Both Sir John Lawrence and Sir Charles Trevelyan concur in this, that not more than one-third of the force should be disposed of in this manner. Such a proportion would enable the remaining two-thirds of the force to take their turn on the hills. But here another question presents itself, viz., what are the points in he plains which must be held? This all important element in the question has not yet been settled. It depends upon the military authorities to do so; and as soon as it has been done, we 5122. 5135. 2964. 5319. 2970, 5319.

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recommend that hill stations conveniently situated for the strategical points should be provided wherever it is possible.

Possibly some of the more unhealthy stations in Lower Bengal could be abandoned without risk to the military occupation of the country, and with great advantage to the health of the army; but, at the same time, it is necessary to bear in mind that the stations in worst repute are in such a bad sanitary condition, that it is not easy to say to what extent the health of the troops might not be improved by suitable works and precautions. It is said of even some of the worst of them that they have never had "fair play" on account of this want of sanitary care.

Vide Kherwarrah Report, p. 400 *post*.

5123. The hill stations must, of course, be at the shortest possible distance from those on the plains; but the introduction of railroads will facilitate their occupation, and enable more distant stations to be used.

4269, 4270. 5342. As regards the Madras Presidency, there would be no difficulty in locating the requisite number of troops on the hills. The Neilgherry range is one great hill station, sufficient for nearly every purpose, and which will shortly be connected, more or less, with every station by railway. Other stations have also been proposed at Ramanmullay, Shevaroy, and the Pulney hills. In the Bengal Presidency the spurs of the Himalaya have been chiefly used; but there are many hill districts besides these worthy of careful examination. The chief hill stations in the Bombay Presidency are at Mahableshwur and Mount Aboo. The former from its local position, as already stated, is very wet; but many other more available points might be discovered.

The result of our inquiry into the important subject of hill stations may be given in a very few words, as follows:—

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, including in this third, by preference, men whose constitutions are becoming enfeebled, and recruits on their first arrival; and to give the other two-thirds their turn.

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 the stations in the plains), in the very best sanitary condition.

SANITARIA.

SANITARIA.

Besides the hill stations, there are several places along the seacoast of India which have been found very useful in restoring health after certain diseases. The most successful of these is Waltair, on the Madras coast, which occupies a range of sand hills close to the sea, fully exposed to the sea breeze. Others have been proposed in India, at the Cape, and especially in Western Australia. The object which these places is intended to serve is not the prevention of disease so much as restoration to health after disease.

SANITARIA.

The Cape of Good Hope has at various times been strongly recommended for this object; but its distance is so great as to render it of doubtful utility, and besides it is alleged that the climate of the Cape is not very suitable for Indian diseases.

Western Australia, though not much nearer, appears to possess many advantages as a locality for a sanitarium.

We have taken evidence on this point from Vice-Admiral Sir James Stirling, K.C.B., late Governor of the Colony; from Staff-Surgeon Rennie, who has been stationed at Fremantle for 6½ years; and from Mr. Roe, Surveyor-General.

It appears from the evidence of these gentlemen, that the climate, although possessing a temperature ranging between 45° and 100° Fahr., is dry, fine, healthy, and invigorating. That the mortality rate is low, and that there are no particular local diseases. That water and supplies are abundant and good, and that the most favourable parts of the colony could be reached from Calcutta and Bombay in about 20 days by sailing vessel, and in from 14 to 16 days by steam. 868–872. 864, 3382. 3355.

The evidence on the subject is not so conclusive as to enable us to recommend the adoption of Western Australia as a position for a sanitarium; but it is sufficient to justify a recommendation that its claims be further inquired into.

We have seen that hill stations are not curative, and that in fact diseased men had better be removed out of India. The only question is whether a complete sanitary system for the Indian army should include a foreign sanitarium, or whether it would not be better to send diseased men home at once. There is much to be said on both sides, but there is no direct evidence of a decisive character either way. It is highly probable that certain cases of disease would so far recover as to enable the sufferers to resume duty after a short residence out of the country, and for this class of cases Australia would be useful. It is on this ground that we would advise further inquiry.

But for cases in which return to comparative health would probably not be accompanied by the likelihood of return to efficient service, the best way would be to send the sufferers home.

As the veterans of the army advance in years the warm climate of India out of the region of malaria appears to suit them. Bangalore is a striking example.

NATIVE LINES.

NATIVE LINES.

Native troops generally hut themselves; but at a few stations there are barracks. Hutting is the rule, and each man receives a small sum from Government for the purpose. The huts are made of very light materials, bamboo and matting, and cost about two rupees. The men generally sleep outside, except in the rains. The huts differ in dimensions, and are not constructed on any general rule. Those for single men, are, say 10 feet long by 7½ wide, and 7 feet high, containing about 525 cubic feet. Stational Reports. 5826.

NATIVE LINES.

A married soldier builds a hut of from 12 to 18 feet long, 12 to 8 feet wide, and 8 to 10 feet high.

The huts are put up without any order or regularity. Nobody interferes; the outline only of the native lines is marked out.

5695. The huts are huddled together, without drainage or attention to ventilation.

5700. Officers sometimes induce the men to arrange the huts in line,
5818. with a space between. But of sanitary supervision there is none.

5729. Natives generally raise the floor of their huts with earth taken from a hole close to the door, in which hole all manner of filth is deposited.

5899. A native cantonment is nothing but a very bad camp, in which every sanitary precaution is ignored, and the water is often very impure.

The only advantage the native possesses is that of having a separate hut.

Native troops, as might be expected, suffer much in efficiency from epidemic disease. According to the returns their mortality is less than that of European soldiers; but many men are sent home from their regiments to die from disease contracted in the
5746–5748. regiment. Such cases are not entered on the death list. The condition of the native lines undoubtedly exerts a very injurious influence upon the troops.

It is usually considered that little or no sanitary improvement can be carried out among natives on account of caste prejudices,
5728, 5730. but it may be doubted whether such is really the case. Natives, it is stated, would make no objection to clearing and levelling ground, drainage, and cleanliness, if it were properly explained to them that it was done only for the protection of their health; they object solely on the ground of cost and trouble; but if the requisite improvements were made without additional cost to themselves, and with full explanations of their nature, it is not likely that any serious difficulty would arise. It is, however, superfluous to observe on the necessity of caution in dealing with this part of the question.

Apart from any consideration of humanity, there would be a saving in improving the condition of native lines. There may be plenty of raw material for soldiers in India, but it requires training and drilling. An efficient native soldier costs money; and when he gets into hospital, or is invalided, or dies, Government incurs great expense in loss of service, medical assistance, &c. Any system of improvement required for stations should therefore include native lines.

NATIVE HOSPITALS.

NATIVE HOSPITALS.

Native hospitals have very few, if any, of the conveniences of hospitals in Europe. They generally consist of a simply-constructed hut, with a pent roof supported on pillars so as to

NATIVE HOSPITALS.

form a verandah. There are numerous doors, and unglazed windows with wooden shutters, which are the usual means of ventilation. Two or three small rooms are generally cut off from the end of the hut or the corners of the verandah, and there is a court behind containing privies, cook-house, dead-house, &c. The hospital construction and administration appear to have been framed on the habits of natives, rather than on what is necessary for the recovery of sick. There seems to be no regulation as to the amount of bed space. The allowance per bed in different hospitals is 294, 386, 570, 620, 840, 1,000, 1,500 up to 1,700 or 1,800 cubic feet. There are no lavatories and no proper baths. The sick wash according to their own habits, and there are tubs in which they can sit to have water poured over them. Ablution is generally performed in the open air in the verandah, or the patients are allowed to go home to wash. In one native hospital the sick are allowed to wash and bathe in a tank in front of it. The means of cleanliness for sick are admitted to be altogether insufficient for medical purposes. The medical officer has no control over diet or cooking, and hence patients often make themselves ill by errors in quantity or quality. The cook-houses have only native fireplaces; they are sometimes close to the privies and dead-houses, and the smell pervades them. The privy is merely a walled off space kept clean by sweepers. In the ordinary sense of hospital offices there are none. Sometimes the surgery is used for all purposes. The attendance on the sick is insufficient. In one hospital of 30 beds the only attendant is the assistant apothecary; but in this, as in other similar cases, native orderlies may be obtained from the regiment. Bedsteads are usually of wood; the natives appear in some cases to supply their own bedding, and in others beds are given out on the requisition of the surgeon. Hospital washing is done by washermen, occasionally by comrades.

Vide Abstracts of Stational Reports.

5881.

Miss Nightingale's observations, p. 332 & 336 *post.*

In practice the sole function of the medical officer in these native hospitals is to order drugs. The only thing done to promote the recovery or comfort of the sick is to supply drugs. In everything else, in diets, baths, &c., the medical officer has no power.

The system seems to be the growth of circumstances, and of an indifferent deference to supposed caste prejudices.

Little attempt seems to have been made to conciliate with such native prejudices or habits the use of means which are essential to the recovery of the native, quite as much as, or more so than to that of the European.

This wise conciliation would effect great improvement in the stations among healthy native soldiers. Could it not be extended also, by considerate inquiry, to the sick?

SANITARY ADMINISTRATION.

SANITARY ADMINISTRATION.

At the three seats of government, Calcutta, Madras, and Bombay sanitary powers are vested in local commissioners appointed by Government. But there appears to be no one on these commissions

SANITARY ADMINISTRATION.

specially conversant with sanitary works. For in each city the sanitary state of the population, as regards drainage, water-supply, cleansing, construction of buildings, and general sanitary arrangements, is as bad as it can well be. It is hardly an exception to this, that Bombay has recently obtained, for the first time since it came under British rule, a water-supply; or that Calcutta is about to be drained, for drainage and water-supply are only two portions of one system, and not two separate systems. Nothing has yet been done in Madras. And as sanitary measures, to be effectual, must be carried out as a whole, and not partially, it cannot be said that even the seats of Government have, up to the present time, made any efficient progress in sanitary improvement.

5305. Sir C. Trevelyan states that, before he left Madras, he prepared a scheme for the reconstruction of the municipality on a sufficiently popular basis to interest the inhabitants; and through this to lay the foundation of sound sanitary improvement, by the introduction of a conjoined system of drainage and water-supply. But up to this present time nothing further has been done.

So far as the evidence before us relates to other large cities and towns, there is no sanitary administration whatever; so that, to all intents and purposes, this important administrative department has to be created for India.

Vide Abstract of Stational Reports. The sanitary police of bazaars is, with few exceptions, of a most inefficient character. The administration seems to vary at different places, and to be confined chiefly to surface cleansing. The power is exercised by the cantonment magistrate, but on no definite system; sometimes carts and sweepers are allowed, in other cases the people are held responsible for their own cleanliness. Certain bazaars and cantonments are described as being "clean." But the majority bear no evidence of any consistent sanitary authority being in existence.

The sanitary state of the lines is under the military authorities and medical officers. But hitherto this part of the administration has been far from efficient, on account of its not being special enough. Referring to this subject, Sir R. Martin states that, although generally throughout India the arrangements are admirable for the cure of disease, they are not at all so for the prevention

200. of disease, that, for this great purpose, they are almost universally

216–218. wanting; that there are no proper sanitary officers; that no knowledge whatever, either of military hygiène or of preventive science, has been exacted from medical officers; that indeed a sanitary department is altogether wanting; that any knowledge obtained by medical officers has been too often obtained at the expense of the soldier.

5498, 5499. An examination of the stational returns shows that the proper functions of officers of health are not even recognized, and that there is neither order nor system in the administration.

Very important improvements have been recently introduced into Her Majesty's service, which will in time remove some of

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the evils so far as stations are concerned. A practical school, in which hygiène is taught, is now in operation at Netley, and all candidates for commissions in the army medical service are required to undergo this course of instruction. In the present transition state of the Indian service all Indian medical officers must also attend this school. In a few years therefore the army will be supplied with a considerable number of men competent for ordinary regimental sanitary work. According to the new medical regulations, in force in Queen's regiments, medical officers have now certain defined sanitary powers in inspecting and reporting to their commanding officers, who are required to carry out their recommendations, or else to state their reasons for non-compliance to the superior military authority. Special sanitary officers can be appointed to this work in garrisons, camps, and stations, or, if such officers are not appointed, the principal medical officer is required to do the duty. Reports are made to commanding officers, and are dealt with as already mentioned.

This procedure was in operation in India during the mutiny, 2209.
and "was leading to an immense amount of good," when the service was discontinued. We are of opinion that, if the regulations were enforced at every station, they would effect all the good they are capable of, so far as the stations are concerned. These regulations, of course, are applicable only to the removal of easily-removed causes of disease. They can effect no improvement as regards drainage, water-supply, the laying out of stations and bazaars, and works generally requiring a large outlay, such as are executed under the Public Works Department.

This department at present has no special sanitary direction, and as we have shown, even the latest constructed barrack errs in the most important particulars.

Much of this evil might be avoided in time to come by requiring all cadets of engineers at Brompton to attend a special course of hygiène, which they have a right to do (by the army medical school regulations).

It follows from what has been said that, except for regimental and certain stational purposes, there is no sanitary authority or administration in India, and no means of bringing the large experience acquired in dealing with sanitary questions, as regards towns, stations, and barracks, including the description of works which have been successfully introduced at home, to bear on the Indian question. The time has now arrived to supply this deficiency in each presidency.

There are no doubt considerable difficulties in the way of organizing an efficient sanitary service for India, and in adapting it to the various exigencies of the country, but there are nevertheless certain leading principles which should be kept in view in any administrative arrangements to be introduced for the purpose. It is, for example, of great importance that the procedure should be as far as possible uniform in each presidency, and this could be best secured by appointing commissions of health, one at each seat of Government, representing the various elements, civil,

SANITARY ADMINISTRATION.

military, engineering, sanitary, and medical, on the co-operation of which depends the solution of many health questions. We are of opinion that such commissions are necessary also to give a practical direction to sanitary improvements and works.

Their functions would be chiefly consultative and advising on all questions relating to the selection and laying out of stations, proper construction of barracks, hospitals, and other buildings, drainage, water supply, cleansing, and general sanitary supervision in stations, cities, and towns, and on the prevention and mitigation of epidemic diseases.

To fulfil the other object of taking advantage of home experience, it would be necessary to afford these commissions every needful information on the most approved and economical methods of laying out sanitary works, and in those healthy principles of construction and improvement of barracks and hospitals which have been successfully carried out in England, but which have still to be introduced into India, and adapted to the circumstances of the country. The sanitary improvements which have been recently introduced at home military stations, and which are about to be carried into effect at certain foreign stations by the War Office, as well as the improved principles of construction in barracks and hospitals now in use, were adopted on the advice of a Commission specially appointed by the War Office to inquire into the subject. The questions which arise out of the evidence from the Indian stations are of the same nature as those which have come under the examination of, and have been dealt with by, the War Office Commission, and it would be highly advisable to make their experience available for India by adding to the existing commission an engineer and a medical officer conversant with Indian sanitary questions, or to form a similar commission in England for this object. Such a commission, if considered preferable, should include members specially conversant with recent improvements, military and civil, an engineer of Indian experience who has given attention to sanitary works, and a medical member acquainted with the sanitary question as it presents itself in India. The function of such a commission could of course be consultative only. It would simply be the medium of advising and informing the Indian Government and the presidency commissions on the latest improvements and on the best principles of sanitary construction. For this purpose, it might give its advice on the healthiness or otherwise of plans, and as to the sanitary details of buildings to be occupied by troops; on the best and most economical methods of water-supply and drainage; it might collect and publish useful information and instructive matter regarding improvements, and it might possibly be able to give a more practical direction to the education of cadets of engineers destined for service in India, to enable them to devise works and improvements on healthy principles.

It would in no way interfere with perfect freedom of action. It would place at the disposal of the Indian Government and presidency commissions the latest experience, classify and generalise

the results of their several publications in a summary form, and thus enable all to arrive at a more satisfactory decision as regards measures to be carried out for protecting the health of troops than would otherwise be possible. Sanitary Administration.

As to the executive authorities by whom sanitary measures will have to be carried into effect, we apprehend that, as regards military buildings and stations, the powers should remain as at present with the department of Public Works, whose plans and proposals would have to be submitted to the presidency commissions for opinion on points affecting health.

All plans of sanitary works and improvements, which might be proposed for native towns connected with stations, should also be submitted for advice and opinion to the presidency commissions.

It would be very advisable to begin this great work with the seats of Government, and to select a few of the more important stations to be thoroughly improved as examples. This course would at once afford the necessary administrative experience, and a basis would be laid for future progress.

Much time must necessarily elapse before much progress is made, but we fear this is inevitable.

Recapitulation.

Our inquiry has shown—

1. That by far the larger proportion of the mortality and inefficiency in the Indian army has arisen from endemic diseases, and notably from fevers, diarrhœa, dysentery, cholera, and from diseases of the liver. Recapitulation.

2. That the predisposition to these diseases is in part attributable to malaria, in conjunction with extremes of temperature, moisture, and variability.

3. But that there are other causes of a very active kind in India connected with stations, barracks, hospitals, and the habits of the men, of the same nature as those which are known in colder climates to occasion attacks of these very diseases, from which the Indian army suffers so severely.

In examining into these causes, we find that the stations generally have been selected without reference to health, and mainly from accidental circumstances, or for political and military reasons. Many of them are situated in low, damp, unhealthy positions, deficient in means of natural drainage, or on river banks, close to unwholesome native cities or towns. Bad selection of stations.

The towns and bazaars in the vicinity of lines are in the worst possible sanitary state, undrained, unpaved, badly cleansed, often teeming with offensive and dangerous nuisances; with tanks, pools, and badly-made surface gutters, containing filth and foul water; the area overcrowded with houses, put up without order or regularity; the external ventilation obstructed, and the houses overcrowded with people; no public latrines, and every spare plot of ground covered with filth in consequence; no water-supply, except what is obtained from bad shallow wells and unwholesome or doubtful tanks. These towns and bazaars are the earliest seats of Bad sanitary state of native towns and bazaars.

RECAPITULATION.

epidemics, especially of cholera, before their ravages extend to the European troops in the vicinity.

Sanitary defects of stations.

None of the stations have any subsoil drainage; and there are no other means of removing the rainfall except surface gutters. The ground about the lines is often broken up in pits and hollows, filled with stagnant water, or it is traversed by unwholesome ravines or nullahs. In certain states of the weather and wind nuisance is experienced in the lines from these causes, and from the foul state of neighbouring native dwellings. Many of the older stations are irregularly built; and the buildings are arranged so as to interfere with each other's ventilation.

Defects in construction of barracks and hospitals.

Both barracks and hospitals are built at or close to the level of the ground, without any thorough draught between the floors and the ground. And the men, both in barrack rooms and sick wards, are exposed to damp and malaria from this cause, as well as from want of drainage. The ventilation is generally imperfect; and from the arrangement of doors and windows, men are exposed to

Over-crowding.

hurtful draughts. Many of the rooms are too high, and as a consequence there is much surface over-crowding, both in barracks and hospitals, although with large cubic space. In a number of instances both the space and area per bed are much too small.

Want of light.

Barracks and hospitals have frequently no glazed windows, and only wooden shutters. Both barrack rooms and sick wards are, as a rule, dark.

Bad position of beds.

There are often four, or even six, rows of beds between the opposite doors or windows, increasing greatly the already existing difficulty of ventilation and exposing the inmates to foul air.

Barrack rooms hold too many men.

The greater proportion of the force is lodged in barracks in such large numbers per room as to be very injurious to health; many of these rooms being several hundreds of feet in length, and some of them containing from a quarter to half of a regiment each!

Defects in water-supply.

Water sources have been, with one or two exceptions, selected without analysis, although it is always hazardous to omit this precaution. The supply is taken from shallow wells and tanks, both of which are very liable to pollution. In a few cases, the water is derived from rivers. It is drawn by dipping, and carried in skins, thereby increasing its impurity. No precautions are taken for purifying drinking water, and the whole arrangement results in a supply of water (for drinking and culinary purposes) of a bad or doubtful quality, and such as would be rejected in any improved sanitary district in this country. This unsatisfactory condition of the water-supply is one of the cardinal defects at Indian stations.

Deficient means of cleanliness.

Ablution and bath accommodation is often very deficient, and sometimes there is none. Very often there are no baths, and where baths exist there are not enough.

Cooking.

Means of cooking are primitive and imperfect, hardly suitable for permanent barracks, although the cooking is considered sufficiently varied.

Latrines and urinals.

Privies and urinals are generally of a bad or defective construction. The contents are removed by hand, often producing great nuisance. No drainage for either privies, ablution rooms, or cook-

houses: the foul water is received into cess-pits or carried away by hand. Recapitulation.

Hospitals are constructed on the same general plan as barracks. They have no proper ablution or bath accommodation; no water-closets, only open privies situated at a distance; no drainage, no water-supply, except what is drawn and carried by hand labour. The bedsteads are often of wood, instead of iron, and mattresses and pillows of various materials, instead of hair, as they ought to be. Hospital defects.

No trained attendants are provided for the sick.

The soldier has a complete ration of good quality; but the ration is not varied to provide against the effects of the soldier's sedentary habits; and no difference is made for the cold and hot season. For the hot season the ration contains too much animal food and too little vegetable. Mutton is not issued often enough. Ration.

Flannel under-clothing would be very advantageous, and a better system of supplying boots for troops is required. Clothing.

The use of spirituous liquors is highly detrimental to the soldier's health in India, and is one of the chief personal habits which injure him physically and morally. Abstinence from spirits has always been attended by greatly improved health, even under circumstances otherwise unfavourable, and by diminution of crime. The only advantage of the issue of spirits in canteens is stated to be that it prevents the soldier from obtaining more unwholesome spirits in the bazaar. The moderate use of malt liquor or light wines is much less injurious to health than spirits. Drink. Intemperance.

Connected with habits of intemperance and want of occupation, is the prevalence of syphilis, a disease which occasions a large amount of inefficiency and invaliding.

Means of recreation are few, of exercise none, of instruction limited. The soldier's habits are sedentary where they ought to be active. He is led into vice and intemperance. He has no means of occupying his time profitably. He complains of the weary sameness and ennui of his life. This, together with his diet, and allowance of spirit and malt liquor, is bad for his health—physical as well as moral health. Deficient means of instruction and recreation.

Making every allowance for the influence of climate, which, however, is altogether secondary, except as increasing the effect of removable causes of disease, the whole tenor of the evidence proves that the bad sanitary conditions enumerated, together with unfavourable habits as to diet, intemperance, and want of occupation, on the part of the men, are causes sufficient to account for a large part of the sickness, mortality, and invaliding occasioned by those diseases from which the army in India mainly suffers. Results of removable causes of disease.

The arrangements for the prevention of disease are either non-existent or most deficient. There are no proper sanitary authorities in towns, no trained officers of health in any town or cantonment, and no means whereby the experience obtained in dealing with sanitary questions at home can be rendered available for India. Until recently, no means on the part of medical officers of State of sanitary administration.

RECAPITULATION.

receiving education in military hygiène and sanitary knowledge existed; there was no recognition of the sanitary element in the army medical service. At present there are no means of bringing trained sanitary knowledge or experience to bear on the selection of sites for stations, or on the laying out of stations or bazaars with the requisite sanitary works, or on the planning or construction of barracks and hospitals on sanitary principles.

Under the new medical regulations, medical officers are empowered to make representations regarding removable causes of disease to commanding officers, which will so far meet the requirements of regiments; but otherwise there is neither order nor system in sanitary administration.

Hill stations.

Hill stations are proposed as a means of being able at once to remove the troops from the influence of climate, malaria, and sanitary defects of stations and barracks into a healthy region. The evidence proves that these stations are useful chiefly for prevention, but not always for cure of disease; that they are suitable for children, and for healthy or ailing men, but not for unhealthy regiments, especially those suffering from bowel complaints; that about a third part of the troops might be located on hill stations, or on other high and healthy positions in rotation, with advantage to health; that although the number of stations in malarious regions should be diminished as far as practicable, and the troops removed to healthier localities, there are certain strategical points (yet undecided) which must be held, whether healthy or unhealthy, and the force on the hills must be considered as a reserve for the purposes of heath.

Although several excellent hill stations are in use, they are not sufficiently convenient for many stations; and an increased number is required. Very careful examination and trial of the climates of new sites should be undertaken. The evidence farther shows that there has been great neglect of sanitary measures at existing hill stations, giving rise to serious disease and mortality.

Elevated plain stations.

Stations on the plains and slopes of India up to 1,500 feet, and on the raised coasts of the sea, are comparatively salubrious. They only require adequate sanitary arrangements.

Lowland stations.

Stations on low inundated lands are hotbeds of malaria.

Native lines.

Native lines are laid out, and huts built, without sufficient reference to health.

There is no drainage, clearing, or levelling, and little attention to cleanliness or ventilation.

Native hospitals are almost altogether wanting in means of personal cleanliness or bathing, in drainage or water-supply, in everything in short except medicine. The medical officer has no control over the patient's diet. There are no trained attendants on the sick. The evidence shows that, by management and conciliation, much might be done to improve the sanitary condition of native lines, as well as the state of native hospitals.

We have, in the course of our inquiries, endeavoured to ascertain the probable excess of mortality in the Indian army occasioned

by the sanitary defects we have described, as well as the reduction of mortality which would follow on the adoption of improvements in existing stations, combined with the use of hill stations, and the abandonment of as many unhealthy localities as may be practicable. The statistical evidence shows that the mortality varies from 11½ per cent. in the most unhealthy, to about 2 per cent. in the most healthy places, even in their present unimproved state. It has been estimated that the lowest of these rates, or 2 per cent., (double the rate at home stations since the introduction of sanitary improvements,) may be taken as the possible mortality under improved sanitary conditions. RECAPITULATION. 4543, 5569.

The annual death rate for the whole of India has hitherto been about 69 per 1,000. The proposed European establishment is 73,000 men, and will, at the present rate of mortality, require 5,037 recruits per annum to fill up the vacancies caused by death alone.

A death rate of 20 per 1,000 would require only 1,460 recruits per annum, so that the excess of mortality is 3,570 lives per annum.

Estimating the cost of recruiting, training, and landing men in India at no more than 100*l.* per man, the excess of mortality will be equivalent in cost to a tax of nearly 1,000*l.* per diem, irrespective of the cost of the extra sickness indicated by a high death rate.

A careful examination of the causes of disease and of the character of the diseases prevalent at the more healthy stations, would lead us to hope eventually for a greater saving of life than we have here estimated. Causes of disease, such as exist at these stations, would, even at home, be sufficient to account for one-half of the 20 per 1,000; and if the time should ever arrive when, under the influence of improved culture, drainage, and sanitary works, India should be freed from the local malaria which exists everywhere there now, as it once did in some form or other over Europe, we may cherish the hope of realizing what statistical inquiries appear to point to, namely, that the natural death rate in times of peace of men of the soldiers' ages in India, will be no more than 10 per 1,000 per annum.

But a reduction of mortality also indicates increased physical strength and greater fitness for duty in the army generally, as well as a smaller proportion of "constantly sick" in hospital; and hence a greater effective numerical strength.

Fewer recruits would be required to supply the losses from disease, a point of very great importance, in regard to which Sir A. Tulloch states that he very much questions whether, with the mortality rate of the last 40 years, it would be possible to keep up an army of 70,000 men in India. And he says that from what he knows of recruiting, this country would not be able to fill up the gaps occasioned by death, and at the same time supply the vacancies occasioned by invaliding, and by the return of time-expired men. 5569.

Apart therefore from the question of humanity, the introduc-

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tion of an efficient system of hygiène in India is of essential importance to the interests of the empire.

The following recommendations are founded on the practical conclusions at which we have arrived.

RECOMMENDATIONS.

RECOMMENDATIONS.

1. 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.

2. That no spirits be issued to troops on board ship, except on the recommendation of the medical officer in charge.

3. That the sale of spirits at canteens be discontinued, except in specific cases on the recommendation of the medical officer, and only malt liquor or light wines allowed. That the sale of spirits in military bazaars be made illegal, and, as far as practicable, suppressed.

4. That the ration be modified to suit the season; that flannel be introduced as under-clothing, and a better system of supplying boots introduced.

5. That the means of instruction and recreation be extended to meet the requirements of each station. That covered sheds for exercise and gymnastics be provided, and that gymnastic exercises be made a parade. That libraries be improved, a better supply of books and periodicals provided, together with reading rooms, well lighted at night. That only coffee, tea, and other non-intoxicating drinks be sold to the men at these rooms. That workshops be established, and also soldiers' gardens, in connexion with the station, wherever practicable. That the proposal made by Sir C. Trevelyan of selecting and educating soldiers of good character for subordinate offices in the administrative departments be tried.

6. That until the mortality be reduced, the period of service in India be limited to 10 years.

7. That provision be made for passing invalids at the port of embarkation without delay, and for their immediate shipment home.

8. That works of drainage and water-supply be carried out at all stations. That all existing water sources be subjected to analysis, and those rejected which contain matters injurious to health. That the present method of drawing and distributing water be discontinued wherever practicable. That all water used for drinking purposes be filtered, or otherwise purified.

9. That all future barracks and hospitals be erected on raised basements, with the air circulating under the floors, and that, in all existing barracks and hospitals, the floors be raised as much as possible, and a free current of air allowed to pass beneath them.

10. That all new barracks be constructed to hold no more than a quarter company in each building, or at most half a company in one building in two separate rooms having no direct communication with each other. That hospitals be constructed in detached

pavilions containing no more than from 20 to 24 beds. That future barracks and hospitals be arranged en échelon to receive the benefit of prevailing winds. And that detached cottages be erected for married soldiers.

11. That barracks and hospitals be in future constructed with single verandahs only; and for no more than two rows of beds between the opposite windows.

12. That the cubic space per man in future barracks be from 1,000 to 1,500 feet, and the superficial area from 80 to 100 square feet, varying according to the airiness of the position. The same space and area to be allotted in existing barracks.

13. That the beds be so arranged, with respect to windows, doors, and wall spaces, as to ensure the benefit of free ventilation, without exposing the men to draughts. That, in existing barracks, where the space between the doors is too small to admit of this, precautions be taken to shelter the beds from draughts. That, in all future barracks, the wall space be made sufficient to keep the beds at the least three feet apart, and at the same time out of the door draught.

14. That the ventilation of barracks and hospitals be sufficiently provided for independently of doors and windows.

15. That in all cavalry barracks, saddlery rooms be provided, and saddles removed out of the barrack rooms.

16. That all barracks and hospitals be provided with sufficient glazed window space to light them, and that they be better lighted at night. Gas to be introduced where practicable.

17. That all barracks be provided with sufficient ablution and bath accommodation, with a constant water-supply. That drinking-fountains supplied with filtered water be provided.

18. That barrack cook-houses be improved and better ventilated.

19. That wherever practicable iron or earthenware water latrines, supplied with water, and drained to an outlet, be introduced instead of the present system; that, where this is impracticable, all cesspits be abolished, and metal or earthenware vessels, to be removed twice a day, substituted. That improved urinals, supplied with a jet for lavatory purposes, as well as with a free supply of water for the cleansing and drainage of the urinals, be provided.

20. On the subject of venereal disease, and the means to be employed for its diminution, we refer to the suggestions made by us under that head in the body of the report.

21. That wherever there is a deficiency of married quarters, the same be supplied.

22. That the cubic space in hospitals be fixed at 1,500 feet and upwards, and the superficial area at from 100 to 120 and 130 square feet per bed, according to the healthiness of the position; and that the wall space per bed be never less than eight feet. In existing hospitals the same space and area to be allowed.

23. That every hospital be provided with a constant supply of pure filtered water, and with drainage.

RECOMMENDATIONS.

24. That every hospital be provided with ablution accommodation, with fixed basins, and with baths, having hot and cold water laid on, conveniently accessible from the wards.

25. That, wherever practicable, water-closets, with drainage and water-supply, be introduced for hospital wards, and privies converted into water latrines.

26. That the hospital diet tables in use at home stations be adopted in India as far as practicable, and the hospitals supplied with properly trained cooks.

27. That trained hospital attendants be introduced into all hospitals, and that female nurses, under the new medical regulations, be introduced into large general hospitals.

28. That in future every regiment in India shall have an adequate number of hospital orderlies from its own ranks to provide personal attendance for the sick.

29. That the number of general hospitals in India be increased by the organization of such hospitals, under the new medical regulations, at the largest European stations.

30. That the strategical points of the country, which must be occupied, be now fixed with special reference to reducing as far as possible the number of unhealthy stations to be occupied.

31. That a sufficient number of hill stations, or of stations on elevated ground, be provided; and that a third part of the force be located on these stations in rotation.

32. That the sanitary duties of regimental, garrison, and inspecting medical officers, prescribed in the new medical regulations of October 7, 1859, be applied or adapted to all stations in India. And that properly trained army medical officers of health be appointed to this service at the larger stations.

33. The Commission entirely approves of medical candidates being required to undergo the course of instruction, including military hygiène, at the army medical school, and are of opinion that practical training in sanitary science is of the greatest importance to the public service.

34. Considering also the constant reference to sanitary subjects necessary in carrying out public works in India, they consider it requisite that every cadet of engineers should attend a course of sanitary instruction at Chatham.

35. In order to the gradual introduction of sanitary improvements for barracks, hospitals, and stations, as well as in the seats of Government and throughout towns in proximity to military stations, they recommend the appointment of commissions of public health, one for each presidency, so constituted as to represent the various elements, civil, military, engineering, sanitary, and medical; to give advice and assistance in all matters relating to the public health, such as selection of new stations and the sanitary improvement of existing stations and bazaars; to examine new plans for barracks and hospitals; to advise on the laying out of stations and bazaars, the sanitary improvement of native towns, prevention and mitigation of epidemic diseases, and generally to exercise a constant oversight on the sanitary condition of the population,

European and native; to report on the prevalence, causes, and means of preventing sickness and disease; and further, that administrative measures be adopted to give effect to the advice of the presidency commissions. That trained medical officers of health be appointed, to act in peace as in war, in connexion with these commissions.

36. That in order to render available for India the experience obtained in dealing with all classes of sanitary questions in England, two officers of the Indian Government be appointed in England to be associated with the War Office Commission for this special purpose; unless it should be thought preferable to appoint a similar commission specially for the Indian Department.

37. That a code of regulations, embodying the duties and adapted to the specialties of the Indian sanitary service, be drawn up and issued under authority.

38. That the system of army medical statistics at present in use at home stations be extended to all stations in India.

39. That a system of registering deaths and the causes of death be established in the large cities of India, and be gradually extended, so as to determine the effects of local causes on the mortality of the native as well as of the European population the results to be tabulated and published annually by the Commissions.

All which we humbly certify to Your Majesty.

(Signed) STANLEY. (L.S.)
PROBY T. CAUTLEY. (L.S.)
J. R. MARTIN. (L.S.)
J. B. GIBSON. (L.S.)
E. H. GREATHED. (L.S.)
W. FARR. (L.S.)
JOHN SUTHERLAND. (L.S.)

Dated 19*th May* 1863.

TABLES REFERRED TO IN THE FOREGOING REPORT.

TABLE 1.—MILITARY FORCE employed in INDIA in 1856 and 1861.

—	Total.		European				Native Troops.	
			Officers.		Non-commissioned Officers and Men.			
	1856.	1861.	1856.	1861.	1856.	1861.	1856.	1861.
ALL ARMS - - - - -	280,325	221,887	5,996	8,324	39,108	75,759	235,221	137,804
Engineers and Sappers - - -	3,360	3,378	237	286	161	300	2,962	2,792
Artillery - - - - -	16,390	16,502	473	804	6,729	11,816	9,188	3,882
Cavalry - - - - -	32,540	26,757	431	811	1,442	6,713	30,667	19,233
Infantry - - - - -	225,772	172,201	4,053	5,573	30,400	56,310	191,319	110,318
Medical Establishment - - -	1,887	2,429	802	850	—	—	1,085	1,579
European Warrant Officers - - -	376	620	—	—	376	620	—	—

TABLE 2.—MILITARY FORCE employed in INDIA in 1856 and 1861.

—	Number of Regiments or Corps.		European Officers.		European Non-commissioned Officers and Men.		Native Troops.		Total.	
	1856.	1861.	1856.	1861.	1856.	1861.	1856.	1861.	1856.	1861.
ALL ARMS	—	—	5,996	8,324	39,108	75,759	235,221	137,804	280,325	221,887
Royal army	—	—	713	2,719	22,867	58,922	—	—	23,580	61,641
Company's army	—	—	5,283	5,605	16,241	16,837	235,221	137,804	256,745	160,246
Royal troops :—										
Artillery	—	22 Battalions.	—	127	—	3,958	—	—	—	4,085
Dragoons	2	8 Regiments.	47	313	1,382	5,359	—	—	1,429	5,672
Infantry	22	49 do.	666	2,279	21,485	49,605	—	—	22,151	51,884
Company's troops :—										
1. Engineers and Sappers	—	—	237	286	161	300	2,962	2,792	3,360	3,378
2. Horse Artillery	5 Brigades.	5 Brigades.	118	196	1,974	2,396	1,120*	499†	3,212	3,091
2a. European Foot Artillery	12 Battalions.	13 Battalions.	225	427	4,725	5,452	3,265‡	1,956‡	8,215	7,835
2b. Native Foot Artillery	6 do.	2 do.	130	54	30	10	4,803‡	1,427‡	4,963	1,491
3. European Cavalry	—	5 Regiments.	—	220	—	1,340	—	—	—	1,560
4. Native Regular Cavalry	21	26 do.	284	220	60	14	9,597	11,767	9,941	12,001
4a. Native Irregular Cavalry	33	16 Corps.	100	58	—	—	21,070	7,466	21,170	7,524
5. European Infantry	9	11 Regiments.	321	539	8,115	6,046	—	—	8,436	6,585
5a. Native Regular Infantry	155	126 do.	2,771	2,471	252	167	152,538	93,370	155,561	96,008
5b. Native Irregular Infantry	45	22 do.	129	115	72	22	35,312	16,948	35,513	17,085
6. Veterans	—	—	166	169	476	470	3,469	—	4,111	639
7. Medical Establishment	—	—	802	850	—	—	1,085§	1,579§	1,887	2,429
8. European Warrant Officers	—	—	—	—	376	620	—	—	376	620

* Includes 451 gun lascars.
† Includes 158 gun lascars.
‡ Includes gun lascars and ordnance drivers.
§ These are described as "apothecaries and stewards" and "native doctors."

TABLE 3.—ANNUAL COST in £ of 1,000 of the QUEEN'S TROOPS in INDIA.

Exclusive of Cost of Staff Charges, Camp Equipage, Ammunition, Arms, Stores, Punkahs, Bedding, Hospital Attendants, Medicines, and Transport in India.

	Infantry.	Cavalry.	Artillery.
Strength { All ranks	1,000	1,000	1,000
Officers	37	58	32
Non-commissioned Officers and Men	963	942	968
	£	£	£
ALL RANKS	81,633	102,400	83,700
I. Officers	20,637	39,368	16,684
II. Non-commissioned Officers and Men	60,996	63,032	67,016
I. Officers :—			
Pay and allowances	17,366	34,362	13,912
Passage money	1,500	2,230	1,240
Non-effective charge	1,771	2,776	1,532
II. Non-commissioned Officers and Men :—			
1. Pay, clothing, and maintenance	43,329	45,420	48,480
2. Passage money	5,569	5,440	5,599
3. Levy money, depôt, and recruiting expenses.	4,716	4,951	5,516
4. Non-effective charge	7,382	7,221	7,421
1. Pay, clothing, and maintenance of Non-commissioned Officers and Men :—			
Pay and allowances	15,150	17,780	20,180
Victuals	8,672	8,480	8,710
Clothing	2,617	2,560	2,630
Barracks	13,150	12,900	13,200
Wives and children of soldiers, good-conduct pay, head money, lascars, &c. &c.	3,740	3,700	3,760
2. Passage money of Non-commissioned Officers and Men :—			
Passages *outwards* of relief regiments	1,509	1,477	1,518
,, *homewards* of regiments recalled	1,348	1,318	1,355
,, *outwards* of drafts	1,512	1,470	1,526
,, *homewards* of invalids	1,200	1,175	1,200
3. Levy money, depôt, and recruiting expenses:—			
Levy money	869	1,493	1,963
Depôt and recruiting expenses for depôt of *one* company.	3,847	3,458	3,553
4. Non-effective charge of Non-commissioned Officers and Men	7,382	7,221	7,421

NOTE.—The Table may be read thus:—The cost of maintaining an infantry regiment in India of 1,000 strong is 81,633*l.*; each soldier costs 81*l.* 6·33 florins, or 81*l.* 12*s.* 8*d.* This is exclusive of the cost of the staff, of arms, ammunition, hospital supplies, &c.

TABLE 4.—AVERAGE ANNUAL MORTALITY at certain Periods of Service in the Three Presidencies of the EFFECTIVES of the European Forces of the late East India Company.

Years of Service.	Average Annual Rate of Mortality per 1,000 in 10 Years.*			
	INDIA.	Bengal.	Madras.	Bombay.
0—1 years - -	65·2	78·1	73·9	31·4
1—2 „ - -	53·6	74·0	40·7	33·4
2—3 „ - -	56·2	61·7	73·3	37·4
3—4 „ - -	49·3	54·2	28·9	66·6
4—5 „ - -	44·1	71·5	20·5	39·9
0—5 „ - -	54·6	68·7	42·9	38·4
5—10 „ - -	47·0	64·0	35·2	36·0
10—15 „ - -	52·8	69·1	43·2	45·3
15—20 „ - -	43·0	62·2	33·1	31·9
20 and upwards -	62·5	76·9	43·3	102·0
Total - -	51·2	67·2	39·5	38·4

* NOTE.—The average annual rate of mortality in the Table is for the 10 years 1847—1856 in the Bengal and Madras presidencies, and for the 10 years 1846–49 and 1851–56 in the Presidency of Bombay. The rate of mortality for this period was considerably below the previous average in Madras and Bombay.

TABLE 5.—INDIA. The CASUALTIES in the EFFECTIVE NON-COMMISSIONED OFFICERS and MEN of the Local European Forces during the Years 1847–56.

Year of Service.	Strength. (Years of Life.)	Casualties.				Rate per Cent.			
		Deaths. (D.)	Invaliding. (I.)	D. + I.	All Causes.	Deaths. (D.)	Invaliding (I.)	D. + I.	All Causes.
0—1 - -	14,390	938	45	983	1,547	6·52	·31	6·83	10·75
1—2 - -	11,630	623	88	711	1,085	5·36	·75	6·11	9·32
2—3 - -	9,220	518	83	601	872	5·62	·90	6·52	9·45
3—4 - -	9,530	470	121	591	907	4·93	1·27	6·20	9·51
4—5 - -	10,120	446	128	574	871	4·41	1·26	5·67	8·60
5—10 -	41,860	1,968	468	2,436	4,048	4·70	1·12	5·82	9·67
10—15 -	21,440	1,131	597	1,728	2,949	5·28	2·78	8·06	13·75
15—20 -	9,976	429	598	1,027	1,424	4·30	6·00	10·30	14·28
20 & upwards	3,090	193	779	972	1,207	6·25	25·21	31·46	39·06

This table is compiled from the Tables of Casualties of Effectives in the Presidencies. Under "invalided" are included here, besides the true invalids, the following casualties:—(1.) Discharged by purchase; (2.) Discharged on account of term expired or otherwise; (3.) Promoted; (4.) Transferred to town major's list; (5.) Transferred to other corps; (6.) Deserted; (7.) Missing, &c.; (8.) Other causes. Those on the town major's list of Bengal are included among the effectives.

TABLE 6.—INDIAN LIFE and SERVICE TABLES for NON-COMMISSIONED OFFICERS and MEN.

(Constructed on the Returns of the European Troops of the late Company during the 10 Years 1847–56.)

Years of Service (x)	Living and Serving.	Decrements in the Five Years following. (x)	Decrements by various Causes.								
			Died in the Service.	Invalided.	Discharged.		Promoted.	Transferred		Deserted.	Missing and other Causes.
					By Purchase.	Time expired.		to Town Major's List.	to other Corps.		
0	100,000	37,915	21,499	3,338	1,543	2,749	93	1,314	5,979	1,242	158
5	62,085	23,543	7,988	3,500	1,458	3,074	284	2,692	4,039	441	67
10	38,542	19,045	7,980	3,634	529	2,496	237	1,211	2,763	128	67
15	19,497	9,893	2,980	4,155	28	653	354	507	1,195	7	14
20	9,604	—	—	—	—	—	—	—	—	—	—
Totals	- -	90,396	40,447	14,627	3,558	8,972	968	5,724	13,976	1,818	306

TABLE 7, showing the Reduction of the CORPS of the EUROPEAN ARMY in INDIA, from ALL CAUSES, in each Year of Service from 0 to 20 :—

Year of Service. (x)	Serving. (l_x)	Annual Decrement. (d_x)	Probable Age.
0	100,000	10,202	21
1	89,798	7,996	22
2	81,802	7,382	23
3	74,420	6,756	24
4	67,664	5,579	25
5	62,085	4,222	26
6	57,863	4,679	27
7	53,184	4,906	28
8	48,278	4,934	29
9	43,344	4,802	30
10	38,542	4,550	31
11	33,992	4,215	32
12	29,777	3,831	33
13	25,946	3,426	34
14	22,520	3,023	35
15	19,497	2,634	36
16	16,863	2,274	37
17	14,589	1,944	38
18	12,645	1,651	39
19	10,944	1,390	40
20	9,604	1,163	41

TABLE 8, showing the Reduction of the CORPS of the EUROPEAN ARMY in INDIA, by DEATH and INVALIDING ALONE, in each Year of Service :—

Year of Service.	Serving.	DIED or INVALIDED Annually.	Probable Age.
0	100,000	6,606	21
1	93,394	5,541	22
2	87,853	5,546	23
3	82,307	4,951	24
4	77,356	4,266	25
5	73,090	4,032	26
6	69,058	3,809	27
7	65,249	3,689	28
8	61,560	3,741	29
9	57,819	3,757	30
10	54,062	3,740	31
11	50,322	3,690	32
12	46,632	3,613	33
13	43,019	3,510	34
14	39,509	3,386	35
15	36,123	3,242	36
16	32,881	3,084	37
17	29,797	2,915	38
18	26,882	2,737	39
19	24,145	2,555	40
20	21,590	2,369	41

TABLE 9, showing the Reduction of the CORPS of the EUROPEAN ARMY in INDIA, from DEATHS ALONE, in each Year of Service from 0 to 20 :—

Year of Service.	Serving.	Annual DEATHS.	Probable Age.
0	100,000	6,312	21
1	93,688	4,888	22
2	88,800	4,853	23
3	83,947	4,040	24
4	79,907	3,445	25
5	76,462	3,366	26
6	73,096	3,286	27
7	69,810	3,206	28
8	66,604	3,127	29
9	63,477	3,047	30
10	60,430	2,967	31
11	57,463	2,886	32
12	54,577	2,805	33
13	51,772	2,723	34
14	49,049	2,641	35
15	46,408	2,559	36
16	43,849	2,476	37
17	41,373	2,392	38
18	38,981	2,308	39
19	36,673	2,224	40
20	34,449	2,140	41

TABLE 10.—ANNUAL RATE of MORTALITY, in Groups of Years, from 1770 to 1856, in each of the PRESIDENCIES.

Years.	Deaths annually to 100 of Strength.			
	INDIA.	Bengal.	Bombay.	Madras.
1770–1800	5·47	7·06	7·82	3·75
1800–1810	7·37	9·15	8·45	5·48
1810–1820	8·48	6·87	9·96	9·70
1820–1830	9·07	8·45	9·79	9·52
1830–1840	5·57	6·01	4·63	5·55
1840–1850	6·54	7·95	6·83	4·35
1850–1856	5·07	6·78	3·11	4·43
1770–1800	5·47	7·06	7·82	3·75
1800–1856	**6·86**	**7·41**	**6·60**	**6·35**
1800–1830	8·46	8·06	9·54	8·43
1830–1856	5·77	6·96	5·04	4·73

TABLE 11.—INDIA.—Average ANNUAL MORTALITY per 1,000 amongst the EFFECTIVE and NON-EFFECTIVE Troops of the late East India Company (Non-commissioned Officers and Men) in 10 Years (1847–56).

Ages.	Years of Life.	Deaths.	Annual Rate of Mortality per 1,000.		Excess of the Rate of Mortality in India.
			Non-commissioned Officers and Men in India.	Males in England.	
Total - -	146,405	7,597	51·9	—	—
10— - -	3,147	83	26·4	5·2	21·2
20— - -	33,813	1,908	56·4	8·7	47·7
25— - -	46,586	2,274	48·8	9·6	39·2
30— - -	30,397	1,509	49·6	10·6	39·0
35— - -	15,953	820	51·4	11·9	39·5
40— - -	7,683	473	61·6	13·9	47·7
45— - -	3,830	220	57·4	16·8	40·6
50— - -	2,140	120	56·1	21·5	34·6
55— - -	1,225	67	54·7	27·6	27·1
60— - -	733	40	54·6	37·8	16·8
65— - -	468	44	94·0	54·8	35·2
70— -	247	20	81·0	81·8	—
75 and upwards	183	19	103·8	121·6	—

The Table may be read thus:—In 33,813 years of life, 1,908 died of the age 20 and under 25, so the mortality was at the rate of 56·4 per 1,000; and as the mortality of men of the corresponding age in England is at the rate of 8·7, the excess of the mortality in India is 47·7 per 1,000.

TABLE 12.—LIFE TABLE for the ENGLISH SOLDIER in INDIA.

AGE.	DYING in each Year of Age.	LIVING at each Age.	SUM of the NUMBERS LIVING at each Age (x), and from x to the last Age in the Table.	LOGARITHMS of the PROBABILITY of LIVING ONE YEAR after the Age x.	LOGARITHMS of the NUMBERS LIVING at each Age.
x	d_x	l_x	L_x	λp_x	λl_x
20	2,052	33,361	607,084	$\bar{1}\cdot9724347$	4·5232361
21	1,811	31,309	573,723	$\bar{1}\cdot9741177$	4·4956708
22	1,618	29,498	542,414	$\bar{1}\cdot9754993$	4·4697885
23	1,462	27,880	512,916	$\bar{1}\cdot9766063$	4·4452878
24	1,336	26,418	485,036	$\bar{1}\cdot9774643$	4·4218941
25	1,234	25,082	458,618	$\bar{1}\cdot9780992$	4·3993584
26	1,150	23,848	433,536	$\bar{1}\cdot9785366$	4·3774576
27	1,081	22,698	409,688	$\bar{1}\cdot9788022$	4·3559942
28	1,024	21,617	386,990	$\bar{1}\cdot9789218$	4·3347964
29	976	20,593	365,373	$\bar{1}\cdot9789211$	4·3137182
30	933	19,617	344,780	$\bar{1}\cdot9788259$	4·2926393
31	896	18,684	325,163	$\bar{1}\cdot9786618$	4·2714652
32	861	17,788	306,479	$\bar{1}\cdot9784546$	4·2501270
33	828	16,927	288,691	$\bar{1}\cdot9782300$	4·2285816
34	794	16,099	271,764	$\bar{1}\cdot9780138$	4·2068116
35	762	15,305	255,665	$\bar{1}\cdot9778316$	4·1848254
36	728	14,543	240,360	$\bar{1}\cdot9777092$	4·1626570
37	692	13,815	225,817	$\bar{1}\cdot9776723$	4·1403662
38	708	13,123	212,002	$\bar{1}\cdot9759219$	4·1180385
39	703	12,415	198,879	$\bar{1}\cdot9746639$	4·0939604
40	685	11,712	186,464	$\bar{1}\cdot9738377$	4·0686243
41	655	11,027	174,752	$\bar{1}\cdot9733829$	4·0424620
42	620	10,372	163,725	$\bar{1}\cdot9732390$	4·0158449
43	581	9,752	153,353	$\bar{1}\cdot9733454$	3·9890839
44	540	9,171	143,601	$\bar{1}\cdot9736417$	3·9624293
45	500	8,631	134,430	$\bar{1}\cdot9740674$	3·9360710
46	463	8,131	125,799	$\bar{1}\cdot9745619$	3·9101384
47	428	7,668	117,668	$\bar{1}\cdot9750647$	3·8847003
48	396	7,240	110,000	$\bar{1}\cdot9755154$	3·8597650
49	371	6,844	102,760	$\bar{1}\cdot9758533$	3·8352804
50	347	6,473	95,916	$\bar{1}\cdot9760181$	3·8111337
51	330	6,126	89,443	$\bar{1}\cdot9759493$	3·7871518
52	317	5,796	83,317	$\bar{1}\cdot9755862$	3·7631011
53	307	5,479	77,521	$\bar{1}\cdot9749480$	3·7386873
54	292	5,172	72,042	$\bar{1}\cdot9748233$	3·7136353
55	272	4,880	66,870	$\bar{1}\cdot9750787$	3·6884586
56	252	4,608	61,990	$\bar{1}\cdot9755803$	3·6635373
57	232	4,356	57,382	$\bar{1}\cdot9761947$	3·6391176
58	215	4,124	53,026	$\bar{1}\cdot9767882$	3·6153123
59	199	3,909	48,902	$\bar{1}\cdot9772273$	3.5921005
60	189	3,710	44,993	$\bar{1}\cdot9773783$	3·5693278
61	180	3,521	41,283	$\bar{1}\cdot9771076$	3·5467061
62	178	3,341	37,762	$\bar{1}\cdot9762816$	3·5238137
63	179	3,163	34,421	$\bar{1}\cdot9747667$	3·5000953
64	183	2,984	31,258	$\bar{1}\cdot9724294$	3·4748620
65	192	2,801	28,274	$\bar{1}\cdot9691359$	3·4472914
66	204	2,609	25,473	$\bar{1}\cdot9647527$	3·4164273
67	216	2,405	22,864	$\bar{1}\cdot9591462$	3·3811800
68	185	2,189	20,459	$\bar{1}\cdot9615239$	3·3403262
69	163	2,004	18,270	$\bar{1}\cdot9632785$	3·3018501
70	145	1,841	16,266	$\bar{1}\cdot9644098$	3·2651286
71	131	1,696	14,425	$\bar{1}\cdot9649180$	3·2295384
72	122	1,565	12,729	$\bar{1}\cdot9648029$	3·1944564
73	122	1,443	11,164	$\bar{1}\cdot9614970$	3·1592593
74	121	1,321	9,721	$\bar{1}\cdot9582913$	3·1207563

Table 12.—Life Table for the English Soldier in India—*cont.*

Age.	Dying in each Year of Age.	Living at each Age.	Sum of the Numbers Living at each Age (x), and from x to the last Age in the Table.	Logarithms of the Probability of Living One Year after the Age x.	Logarithms of the Numbers Living at each Age.
x	d_x	l_x	L_x	λp_x	λl_x
75	119	1,200	8,400	$\bar{1}\cdot9548413$	3·0790476
76	115	1,081	7,200	$\bar{1}\cdot9511367$	3·0338889
77	111	966	6,119	$\bar{1}\cdot9471672$	2·9850256
78	105	855	5,153	$\bar{1}\cdot9429225$	2·9321928
79	99	750	4,298	$\bar{1}\cdot9383922$	2·8751153
80	92	651	3,548	$\bar{1}\cdot9335660$	2·8135075
81	85	559	2,897	$\bar{1}\cdot9284336$	2·7470735
82	77	474	2,338	$\bar{1}\cdot9229846$	2·6755071
83	69	397	1,864	$\bar{1}\cdot9172088$	2·5984917
84	61	328	1,467	$\bar{1}\cdot9110958$	2·5157005
85	52	267	1,139	$\bar{1}\cdot9046352$	2·4267963
86	45	215	872	$\bar{1}\cdot8978169$	2·3314315
87	38	170	657	$\bar{1}\cdot8906302$	2·2292484
88	31	132	487	$\bar{1}\cdot8830651$	2·1198786
89	25	101	355	$\bar{1}\cdot8751113$	2·0029437
90	20	76	254	$\bar{1}\cdot8667581$	1·8780550
91	16	56	178	$\bar{1}\cdot8579955$	1·7448131
92	12	40	122	$\bar{1}\cdot8488131$	1·6028086
93	8	28	82	$\bar{1}\cdot8392005$	1·4516217
94	7	20	54	$\bar{1}\cdot8291475$	1·2908222
95	4	13	34	$\bar{1}\cdot8186437$	1·1199697
96	3	9	21	$\bar{1}\cdot8076787$	0·9386134
97	3	6	12	$\bar{1}\cdot7962424$	0·7462921
98	1	3	6	$\bar{1}\cdot7843241$	0·5425345
99	1	2	3	$\bar{1}\cdot7719138$	0·3268586
100	—	1	1	$\bar{1}\cdot7590011$	0·0987724

Formulas. x = age; and ω the last age of life.

$d_x = l_x - l_{x+1}$

$L_x = l_x + l_{x+1} + l_{x+2} \ldots\ldots\ldots l_\omega$.

$\frac{l_{x+n}}{l_x}$ = the probability that the soldier will live n years after the age x.

$\frac{l_x}{2} = l_{x+n}$; where n is the *probable duration of life* after the age x.

$p_x = \frac{l_{x+1}}{l_x}$ = the probability that a soldier will live 1 year after the age x.

$\mu_x = 1 - p_x = \frac{l_x - l_{x+1}}{l_x} = \frac{d_x}{l_x}$ = probability of dying in the year after x; *incorrectly called, in several of the Reports on the Indian Funds, the "rate of mortality."*

$m_x = \frac{2d_x}{l_x + l_{x+1}}$ = rate of mortality in the year of age after x.

By the following two formulas the *mortality* can be deduced from the *probability of dying* (μ), and conversely the *probability of dying* can be deduced from the mortality (m). $m = \frac{2\mu}{2-\mu}$; and $\mu = \frac{2m}{2+m}$

Note.—This Life Table from age 20 to 72 has been constructed upon the basis of the rate of mortality obtained from the tables relating to the non-commissioned officers and men (effective and non-effective) of the European troops of the late East India Company. It was found that at age 72 the λp_x of the Indian army corresponded nearly exactly with that of the English Life Table No. 3, and as the Indian facts did not extend beyond that age, the table was completed by means of the λp_x as given in the English Life Table No. 3. The col. l_x starts from the same base as the English Life Table No. 3,—at age 20,—but reduced on the assumption that 100,000 instead of 1,000,000 formed the starting point at age 0.

This Table differs from any life tables relating to Indian officers in this respect, that whereas they deal with officers residing in India, say from age 20 to 40 or 45, and then returning to live in England, this Table refers exclusively to soldiers *in India* at the later as well as at the earlier period of life.

TABLE 13.—LIFE ANNUITY TABLE for the ENGLISH SOLDIER in INDIA.

Age.	3 PER CENT.			5 PER CENT.		
x	D_x	N_x	λD_x	D_x	N^x	λD_x
20	18,471	228,458	4·2664916	12,573	128,231	4·0994501
21	16,830	209,987	4·2260891	11,238	115,658	4·0506955
22	15,395	193,157	4·1873696	10,084	104,420	4·0036239
23	14,126	177,762	4·1500316	9,077	94,336	3·9579339
24	12,996	163,636	4·1138007	8,191	85,259	3·9133509
25	11,979	150,640	4·0784278	7,407	77,068	3·8696259
26	11,058	138,661	4·0436898	6,707	69,661	3·8265358
27	10,219	127,603	4·0093891	6,080	62,954	3·7838831
28	9,448	117,384	3·9753541	5,514	56,874	3·7414960
29	8,739	107,936	3·9414387	5,003	51,360	3·6992285
30	8,082	99,197	3·9075226	4,539	46,357	3·6569603
31	7,473	91,115	3·8735112	4,117	41,818	3·6145969
32	6,908	83,642	3·8393358	3,733	37,701	3·5720694
33	6,382	76,734	3·8049532	3,383	33,968	3·5293347
34	5,893	70,352	3·7703460	3,065	30,585	3·4863754
35	5,439	64,459	3·7355225	2,775	27,520	3·4431999
36	5,018	59,020	3·7005169	2,511	24,745	3·3998422
37	4,628	54,002	3·6653889	2,272	22,234	3·3563621
38	4,268	49,374	3·6302240	2,055	19,962	3·3128451
39	3,920	45,106	3·5933086	1,852	17,907	3·2675777
40	3,590	41,186	3·5551353	1,664	16,055	3·2210523
41	3,282	37,596	3·5161358	1,492	14,391	3·1737007
42	2,997	34,314	3·4766815	1,336	12,899	3·1258943
43	2,736	31,317	3·4370832	1,197	11,563	3·0779440
44	2,498	28,581	3·3975914	1,072	10,366	3·0301001
45	2,282	26,083	3·3583959	961	9,294	2·9825525
46	2,087	23,801	3·3196261	862	8,333	2·9354306
47	1,911	21,714	3·2813507	774	7,471	2·8888032
48	1,752	19,803	3·2435782	696	6,697	2·8426786
49	1,608	18,051	3·2062564	627	6,001	2·7970047
50	1,477	16,443	3·1692725	565	5,374	2·7516687
51	1,357	14,966	3·1324533	509	4,809	2·7064975
52	1,246	13,609	3·0955654	458	4,300	2·6612575
53	1,144	12,363	3·0583144	413	3,842	2·6156544
54	1,048	11,219	3·0204252	371	3,429	2·5694132
55	960	10,171	2·9824112	333	3,058	2·5230472
56	880	9,211	2·9446527	300	2,725	2·4769366
57	808	8,331	2·9073958	270	2,425	2·4313276
58	743	7,523	2·8707533	243	2,155	2·3863330
59	683	6,780	2·8347042	220	1,912	2·3419319
60	630	6,097	2·7990943	199	1,692	2·2979699
61	580	5,467	2·7636354	180	1,493	2·2541589
62	534	4,887	2·7279058	162	1,313	2·2100772
63	491	4,353	2·6913501	146	1,151	2·1651695
64	450	3,862	2·6532796	131	1,005	2·1187469

Table 13.—Life Annuity Table for the English Soldier in India—*cont.*

Age.	3 per Cent.			5 per Cent.		
x	D_x	N_x	λD_x	D_x	N_x	λD_x
65	410	3,412	2·6128718	117	874	2·0699870
66	371	3,002	2·5691705	104	757	2·0179336
67	332	2,631	2·5210859	92	653	1·9614970
68	293	2,299	2·4673949	79	561	1·8994539
69	261	2,006	2·4160816	69	482	1·8397885
70	233	1,745	2·3665229	61	413	1·7818777
71	208	1,512	2·3180954	53	352	1·7250982
72	186	1,304	2·2701762	47	299	1·6688269
73	167	1,118	2·2221419	41	252	1·6124405
74	148	951	2·1708017	36	211	1·5527482
75	131	803	2·1162557	31	175	1·4898502
76	114	672	2·0582598	27	144	1·4235022
77	99	558	1·9965593	23	117	1·3534496
78	85	459	1·9308893	19	94	1·2794275
79	73	374	1·8609745	16	75	1·2011607
80	61	301	1·7865295	13	59	1·1183636
81	51	240	1·7072583	11	46	1·0307403
82	42	189	1·6228547	9	35	0·9379846
83	34	147	1·5330020	7	26	0·8397799
84	27	113	1·4373736	5	19	0·7358094
85	22	86	1·3356322	4	14	0·6257059
86	17	64	1·2274302	3	10	0·5091518
87	13	47	1·1124099	2	7	0·3857794
88	10	34	0·9902028	2	5	0·2552203
89	7	24	0·8604307	1	3	0·1170361
90	5	17	0·7227048	1	2	$\bar{1}$·9710181
91	4	12	0·5766257	1	1	$\bar{1}$·8165869
92	3	8	0·4217839	—	—	—
93	2	5	0·2577598	—	—	—
94	1	3	0·0841231	—	—	—
95	1	2	$\bar{1}$·9004334	—	—	—
96	1	1	$\bar{1}$·7062398	—	—	—

Formulas. i = interest of 1*l.* in one year.

$\frac{1}{1+i} = v$; and $d = 1-v$.

v^x = the value of 1*l.* payable at the end of x years.

$D_x = v^x l_x$

$N = D_x + D_{x+1}$ . . . . . .

$\frac{N}{D_x} = A_x$ = the value of an annuity of 1*l.* payable at the beginning of every year of life.

$\frac{D_x}{N_x} = \frac{1}{A_x} = a^x$ = life annuity which 1*l.* will purchase.

Note.—This Table was formed from the col. l of the Life Table for the English soldier in India.

TABLE 14.—COMPARATIVE NUMBERS LIVING and DYING in each Year of Age amongst ENGLISHMEN remaining at Home and ENGLISHMEN going to INDIA, as Soldiers and Civilians, at the Age of 20.

Age. x.	Englishmen remaining at Home.		Englishmen going to Madras as Civilians at the Age of 20.		Officers serving in India after the Age of 20.		Englishmen going to India at the Age of 20 as Soldiers.	
	Living.	Dying in the next Year.	Living.	Dying in the next Year.	Living.	Dying in the next Year.	Living.	Dying in the next Year.
15	34,429	178	34,429	178	34,429	178	34,429	178
16	34,251	193	34,251	193	34,251	193	34,251	193
17	34,058	211	34,058	211	34,058	211	34,058	211
18	33,847	232	33,847	232	33,847	232	33,847	232
19	33,615	254	33,615	254	33,615	254	33,615	254
	At Home.		Civilians in Madras.		Officers in India.		Soldiers in India.	
20	33,361	276	33,361	353	33,361	865	33,361	2,052
21	33,085	281	33,008	412	32,496	840	31,309	1,811
22	32,804	283	32,596	452	31,656	819	29,498	1,618
23	32,521	287	32,144	472	30,837	950	27,880	1,462
24	32,234	290	31,672	476	29,887	921	26,418	1,336
25	31,944	292	31,196	469	28,966	893	25,082	1,234
26	31,652	296	30,727	462	28,073	865	23,848	1,150
27	31,356	298	30,265	456	27,208	836	22,698	1,081
28	31,058	301	29,809	449	26,372	897	21,617	1,024
29	30,757	304	29,360	444	25,475	865	20,593	976
30	30,453	307	28,916	438	24,610	836	19,617	933

TABLE 15.—LIFE TABLE for PENSIONERS who have served in EAST and WEST INDIES.

AGE.	DYING in each Year of Age.	LIVING at each Age.	Sum of the NUMBERS LIVING at each Age (x), and from x to the last Age in the Table.	LOGARITHMS of the PROBABILITY of Living One Year after the Age x.	LOGARITHMS of the NUMBERS LIVING at each Age.
x	d_x	l_x	L_x	λp_x	λl_x
40	269	11,712	266,931	$\bar{1}\cdot9899345$	4·0686243
41	285	11,443	255,219	$\bar{1}\cdot9890168$	4·0585588
42	296	11,158	243,776	$\bar{1}\cdot9883312$	4·0475756
43	300	10,862	232,618	$\bar{1}\cdot9878462$	4·0359068
44	299	10,562	221,756	$\bar{1}\cdot9875305$	4·0237530
45	294	10,263	211,194	$\bar{1}\cdot9873525$	4·0112835
46	288	9,969	200,931	$\bar{1}\cdot9872809$	3·9986360
47	279	9,681	190,962	$\bar{1}\cdot9872840$	3·9859169
48	271	9,402	181,281	$\bar{1}\cdot9873306$	3·9732009
49	261	9,131	171,879	$\bar{1}\cdot9873890$	3·9605315
50	253	8,870	162,748	$\bar{1}\cdot9874280$	3·9479205
51	246	8,617	153,878	$\bar{1}\cdot9874159$	3·9353485
52	241	8,371	145,261	$\bar{1}\cdot9873214$	3·9227644
53	238	8,130	136,890	$\bar{1}\cdot9871130$	3·9100858
54	237	7,892	128,760	$\bar{1}\cdot9867592$	3·8971988
55	239	7,655	120,868	$\bar{1}\cdot9862286$	3·8839580
56	243	7,416	113,213	$\bar{1}\cdot9854897$	3·8701866
57	252	7,173	105,797	$1\cdot9845111$	3·8556763
58	261	6,921	98,624	$\bar{1}\cdot9832613$	3·8401874
59	259	6,660	91,703	$\bar{1}\cdot9827775$	3·8234487
60	255	6,401	85,043	$\bar{1}\cdot9823750$	3·8062262
61	253	6,146	78,642	$\bar{1}\cdot9817490$	3·7886012
62	253	5,893	72,496	$\bar{1}\cdot9809030$	3·7703502
63	256	5,640	66,603	$\bar{1}\cdot9798402$	3·7512532
64	259	5,384	60,963	$\bar{1}\cdot9785639$	3·7310934
65	264	5,125	55,579	$\bar{1}\cdot9770774$	3·7096573
66	268	4,861	50,454	$\bar{1}\cdot9753841$	3·6867347
67	272	4,593	45,593	$\bar{1}\cdot9734872$	3·6621188
68	275	4,321	41,000	$1\cdot9713900$	3·6356060
69	278	4,046	36,679	$\bar{1}\cdot9690959$	3·6069960
70	279	3,768	32,633	$\bar{1}\cdot9666080$	3·5760919
71	278	3,489	28,865	$\bar{1}\cdot9639298$	3·5426999
72	275	3,211	25,376	$\bar{1}\cdot9610646$	3·5066297
73	271	2,936	22,165	$\bar{1}\cdot9580155$	3·4676943
74	263	2,665	19,229	$\bar{1}\cdot9547860$	3·4257098
75	255	2,402	16,564	$\bar{1}\cdot9513794$	3·3804958
76	243	2,147	14,162	$\bar{1}\cdot9477988$	3·3318752
77	230	1,904	12,015	$\bar{1}\cdot9440478$	3·2796740
78	216	1,674	10,111	$\bar{1}\cdot9401294$	3·2237218
79	199	1,458	8,437	$1\cdot9360471$	3·1638512
80	183	1,259	6,979	$\bar{1}\cdot9318041$	3·0998983
81	166	1,076	5,720	$\bar{1}\cdot9274037$	3·0317024
82	148	910	4,644	$\bar{1}\cdot9228493$	2·9591061
83	131	762	3,734	$\bar{1}\cdot9181442$	2·8819554
84	114	631	2,972	$\bar{1}\cdot9132916$	2·8000996
85	99	517	2,341	$\bar{1}\cdot9082948$	2·7133912
86	83	418	1,824	$\bar{1}\cdot9031572$	2·6216860
87	70	335	1,406	$\bar{1}\cdot8978820$	2·5248432
88	58	265	1,071	$\bar{1}\cdot8924726$	2·4227252
89	48	207	806	$\bar{1}\cdot8869322$	2·3151978
90	38	159	599	$\bar{1}\cdot8812641$	2·2021300
91	30	121	440	$\bar{1}\cdot8754718$	2·0833941
92	24	91	319	$\bar{1}\cdot8695583$	1·9588659

Table 15.—Life Table for Pensioners, &c.—*continued.*

Age.	Dying in each Year of Age.	Living at each Age.	Sum of the Numbers Living at each Age (x), and from x to the last Age in the Table.	Logarithms of the Probability of Living One Year after the Age x.	Logarithms of the Numbers Living at each Age.
x	d_x	l_x	L_x	λp_x	λl_x
93	18	67	228	$\bar{1}\cdot8635271$	1·8284242
94	14	49	161	$\bar{1}\cdot8573815$	1·6919513
95	10	35	112	$\bar{1}\cdot8511247$	1·5493328
96	7	25	77	$\bar{1}\cdot8447601$	1·4004575
97	6	18	52	$\bar{1}\cdot8382910$	1·2452176
98	4	12	34	$\bar{1}\cdot8317206$	1·0835086
99	3	8	22	$\bar{1}\cdot8250522$	0·9152292
100	1	5	14	$\bar{1}\cdot8182892$	0·7402814
101	2	4	9	$\bar{1}\cdot8114349$	0·5585706
102	1	2	5	$\bar{1}\cdot8044926$	0·3700055
103	0	1	3	$\bar{1}\cdot7974655$	0·1744981
104	0	1	2	$\bar{1}\cdot7903569$	$\bar{1}\cdot9719636$
105	1	1	1	$\bar{1}\cdot7831702$	$\bar{1}\cdot7623205$

Note.—This Table was formed from the column "Logarithms of the Value of Chance of Surviving," given in a Table relating to Pensioners who have served in East and West Indies, on pages 6 and 7 of Appendix to Report on "Charge for Non-effective Services of Troops of the Line in India."

Table 16.—Annual Rate of Mortality amongst Males of the Age x in England and in India.

Age. (x)	Deaths annually to 1,000 living.					
	Males in Healthy Districts of England.	Males in England and Wales.	Soldiers in India.	Pensioners who have served in East and West Indies.	Madras Civil Service (1760–1853).	Officers retired from the Indian Army.
22	7·3	8·7	56·4	—	14·0	10·8
27	8·0	9·6	48·8	—	15·2	11·3
32	8·4	10·6	49·6	—	15·5	12·2
37	8·9	11·9	51·4	—	16·3	13·6
42	9·9	13·9	61·6	26·9	17·9	15·8
47	11·6	16·8	57·4	29·2	20·4	19·6
52	14·4	21·5	56·1	29·2	25·2	24·9
57	18·5	27·6	54·7	35·8	28·4	32·0
62	28·9	37·8	54·6	43·9	29·7	41·2
67	44·4	54·8	94·0	61·0	35·7	53·5
72	67·9	81·8	81·0	89·5	50·5	79·7
77	103·7	121·6	103·8	128·6	85·0	116·0

Note.—The mortality in the Healthy Districts and amongst the Pensioners and Madras Civil Service, has been deduced from the respective Life Tables by the formula $m_x = \frac{2\,d^x}{l_x + l_{x+1}}$ The mortality of England and Wales is taken from the English Life Table No. 3, and for Soldiers in India from the Tables published in the Sanitary Statistics, folio edition, vol. I. The mortality of Officers retired from Indian army has been obtaine from a Table in the Statistical Journal for 1838 (vol. i. p. 280), by the formula $m = \frac{2\,\mu}{2-\mu}$

(*a*) Extract from the Registrar-General's Annual Summary of the London Tables of Mortality, 1859, referred to in section 12.

It may be instructive to compare the fatality by some of the diseases of London now (1859) and in the seventeenth century. In the twenty years, 1660–79, the mortality in Southwark and in the City within and without the walls was at the rate of 7 or 8 per cent.; so the mortality within the bills may be set down at the rate of 7,000 annually in every 100,000 living, of which 3,400 were by zymotic diseases.

The diseases were not always distinguished accurately. But by putting them in groups, any fallacy from this source will be obviated, and the decrease of some of the worst forms of mortal disease will be placed beyond doubt. To render the comparison easy, the number living is taken to be the same in the two periods, 100,000 in 1660–79 and in 1859. The annual deaths by small-pox were 357 in the first period, 42 in the second period; by measles 40 and 47 in the two periods. Medical science was imperfect, and the science existing in that century was very imperfectly applied. Croup and scarlatina were not generally recognized, but were confounded with measles and fever. The mortality by fever, continued or remittent, and ague was at the rate of 749 and 59 in the two periods; or including scarlatina, quinsy and croup, the mortality was 759 and 227. Thus a person was in four times as much danger of dying of these diseases at the Restoration as a person living in London now. Women are not yet entirely exempt from peril in child-bearing; the mortality by that disease is now 17, it was then 86. Again a few (8) in 100,000 die now of dysentery; then out of the same number, 763 died annually of that disease. By diarrhœa, a milder form of disease, 11 died then, 120 die now; cholera was fatal in 1859 to 7, and in the 20 years (1660–79) to 130 annually. Syphilis was twice as fatal as it is, the numbers being 21 and 12. Scurvy and purpura bear testimony to the imperfect nutrition of the population; the annual deaths were then 142 and are now 2. Vegetables, fruit, and fresh meat could with difficulty be procured in winter. Worms and all parasitic creatures that crawl over, bite, and prey on the body of man, were prevalent; 10 deaths were ascribed to worms.

Dropsy, a frequent result and sign of scurvy and fever, was exceedingly fatal; 298 died of that disease then, and 26 now. Apoplexy, paralysis, epilepsy, affections of the brain, and suicide, are more fatal now, according to the returns, than they were in the proportion of 57 then to 151 now.

Consumption and diseases of the breathing organs were uncommonly fatal; 1,079 then and 611 now are the figures of the mortality. Diseases of the digestive organs were fatal then and now in the proportion of 146 and 95. Stone and diseases of the urinary organs are now as fatal as they were then; the deaths being 21 and 30. Children were rapidly cut down; of convulsions and teething, 1,175 died then, 136 (too many) now.

Of the violent deaths, some are now more frequent, as the forces by which they are occasioned are greater; of fractures and wounds 19 died then, 25 now; of poison, more accessible, 2 now and then only 1; of burns, as fires are probably more common, and dresses more inflammable, now 13, then 3; drowning and suffocation were then twice as fatal (23 and 20) as they are (10 and 10) in the present day.

Five in 100,000 of the people were executed then annually; now one in the whole population.

In addition, the inhabitants of London were then destroyed by the terrible plague; which, upon an average of the 20 years, carried off 1,132 lives.

In 1665 nearly a third of the population perished by plague. It is difficult to conceive this frightful destruction of human life ; the imagination, the wailing notes of writers, the details of Defoe in a work which would have immortalized any writer, fail to bring all the horrors before our minds.

The mortality was at the rate of *seven* per cent. on an average during the 20 years. If the mortality of London had been at the same rate in the last year, instead of 61,617 about 194,200 deaths would have been registered.

The plague was the more appalling as the mortality overwhelmed the people in particular years ; thus the burials from 15,356 in 1663, rose to 97,306, "whereof 68,596 were by plague," in 1665 ; and this was equivalent to more than 600,000 deaths by plague in the present population of London. In the third week of September 8,297 deaths were registered, which represents a rate of mortality equivalent to about 85,000 deaths in a week on the actual population of London.

In these recurring plagues vast numbers of people fled in panic terror from the fatal city ; servants and workpeople were discharged in great numbers ; commerce was paralyzed ; few ships ventured up the river, and merchant vessels were occupied by their owners as asylums on the water. Sextons, gravediggers, bearers, bellmen, and drivers of death-carts were in demand. The dead were buried indiscriminately ; some bodies lay in forsaken houses, others across the paths in the streets, no longer traversed by carts or coaches. At the end of the summer grass was growing in Bishopsgate-street and Cornhill, where the people thronged no longer. The loud voices, shrieks and sobs of the delirious, the desolate, and the dying were heard in the streets ; at times too disturbed by reckless revellers, and by raving patients, who had escaped from their dwellings, converted into prisons. For according to the regulations "infected houses" were shut up ; a red cross and "Lord have mercy upon us !" were inscribed on their portals ; while watchmen jealously guarded the doors. These quarantine regulations were at first rigidly carried out, and were only gradually abandoned when they were found useless, pernicious, and impracticable.

It is of some use to ask whether these past occurrences possess merely a historical interest for the inhabitants of London. Are the diseases of those times ever likely to recur ? The answer must be :— undoubtedly they will recur, if their causes come again into action ; and not otherwise. If a comet—if the stars—if volcanic action—if some mystical telluric influence destroyed the population of London at the rate of 7 per cent. annually, and at times in paroxysms at the rate of 20 and 30 per cent. in a single year, such powers are evidently beyond the reach of the will, and of all human effort. The population must resign itself to its fate. Vesuvius may perhaps be extinguished artificially ; but the cause of the volcanic action which pervades the world is inaccessible.*

All the evidence, however, goes to show that comets, stars, and volcanic action had as much to do with the mortality of the population of London in the seventeenth century as with the mortality of the British troops in the Crimea ; and no more. The supply of food, and particularly of vegetable and fresh animal food, in certain seasons of the year, was defective, so that a large portion of the population became scorbutic. The houses were nearly as close and dirty as the houses now are in Constantinople and Cairo ; the water supply was imperfect

* *See* the "History of Epidemics" by Hecker, and the ingenious book of Mr. Parkin.

as London Bridge works and Hugh Middleton's New River were for many years unappreciated. Water has in itself little attraction for people unaccustomed to ablution. Parasitic insects and diseases of the skin betrayed its impurities. The dirt of the houses struck foreigners. The sewers were imperfect; and the soil gave off marsh malaria in some parts, and in others was saturated with the filth of successive generations.

The high rates of mortality which then prevailed still attend cholera and current epidemics in certain localities. The nature of disease and the climate are still the same as they were in London before the Revolution; and it is evident that if plague has disappeared, other zymotic diseases, but notably dysentery, scurvy, and fever, have declined. Cholera was on an average then as fatal as it has been recently, and probably much more fatal than it will be again if London be supplied with pure water.

The nation exults justly in the progress of its manufactures. But the progress of its manufactures is surpassed by the progress of the health of its capital.

The improvement in the health of London has proceeded step by step with the amendment of the dietary, the drainage of the soil on which the houses stand, the purification of the water which the people drink; with the sweetening of the air; and with the progress of medical science, which is the source of sound sanitary doctrines.

So long as these improvements are maintained, the diseases of the seventeenth century will not recur; and all further progress is in the hands of the people. They can work out their own salvation, with God's blessing. The causes of disease are numerous; but every one that has hitherto been discovered can be to a certain extent controlled. If by persevering in the exact observation and analysis of the diseases of the population, science succeeds in bringing to light the evils of unnatural diseases still existing, we may hope confidently that those evils will be averted; and that, rising from the Thames, the site of London, which was pronounced in the seventeenth century a field of blood and terror, will be a field of health, concourse, and security to the population of the Metropolis of the Empire.

TABLE 17.—ANNUAL RATE of MORTALITY per 1,000 among OFFICERS of the INDIAN ARMY.

Ages.	Colonel Henderson (1814–1833).			Ages.	Mr. Neison (1800-1847).	Mr.G.Davies (1760-1839).
	Years of Life in the Service.	Deaths.	Mortality per 1,000.			
18—	9,122	205	22·73	15—	14·59	26·49
20—	20,830	603	29·37	20—	23·51	27·18
25—	16,731	540	32·80	25—	25·33	28·39
30—	12,329	429	35·41	30—	28·18	30·76
35—	9,635	371	39·26	35—	29·06	33·42
40—	6,770	268	40·39	40—	30·15	37·06
45—	3,088	141	46·72	45—	38·65	41·45
50—	1,725	73	43·22	50—	30·27	—
55—	963	43	45·65	55—	42·90	—
60—	723	36	51·06	60—	40·00	—
65—	506	39	80·08			
70—	180	20	117·65			

TABLE 18.—MORTALITY per Cent. in the following Periods of Years among those Officers in the Bengal Army who have received their Appointments during the present Century. (Constructed from Henderson and Neison's Tables. *See* Neison's Report on Bengal Military Fund, p. 11.)

Ages.	Mortality per Cent.		
	1800–19.	1820–39.	1840–47.
15—	1·591	1·354	1·128
20—	2·303	2·038	2·492
25—	2·019	2·444	3·226
30—	3·102	2·282	3·389
35—	1·787	2·630	3·137
40—	- -	2·455	3·586
45—	- -	3·026	4·364
50—	- -	4·289	2·732
55—	- -	3·999	4·720
60—	- -	- -	4·013

TABLE 19.—MORTALITY amongst OFFICERS who entered the MADRAS MILITARY FUND from 1808 to 1857, including those who continued Members after Retirement.

Ages.	Years of Life.	Deaths.	Mortality per Cent.
14—	4,835	142	2·937
20—	16,013	531	3·316
25—	25,848	834	3·226
35—	13,783	403	2·994
45—	7,137	196	2·746
55—	2,614	78	2·983
65—	933	49	5·252
75—	146	17	11·645
85—	4	1	25·000

The Table may be read thus:—At the age 25–35, out of 25,848 years of life, there were 834 deaths, or 3·226 per cent., amongst the OFFICERS of the Madras Military Fund, from 1808 to 1857.—(Facts supplied by Mr. SAMUEL BROWN.)

TABLE 20.—MORTALITY amongst the WIVES of OFFICERS in the MADRAS ARMY, 1808 to 1857 inclusive.

Ages.	Years of Life.	Deaths.	Mortality per Cent.
15—	879	17	1·934
20—	3,946	68	1·723
25—	9,435	117	1·240
35—	5,337	73	1·368
45—	2,059	18	·874
55—	511	7	1·370
65—	—	—	—
75—	—	—	—
—	—	—	—

TABLE 21.—MORTALITY amongst the WIDOWS of OFFICERS in the MADRAS ARMY from 1808 to 1857 inclusive (chiefly in England).

Ages.	Years of Life.	Deaths.	Mortality per Cent.
15—	32	—	—
20—	273	2	·733
25—	1,771	27	1·525
35—	2,547	30	1·178
45—	2,019	35	1·733
55—	1,253	22	1·756
65—	408	17	4·166
75—	59	7	11·864
—	—	—	—

TABLE 22.—MEAN AFTER LIFETIME (Expectation of Life) of MALES at the Age x in ENGLAND and in INDIA.

Age. (x)	Healthy Districts of England.	All England.	Madras Civil Service.	Officers serving in India. (Colonel Henderson.)	Soldiers in India.	Pensioners who have served in East and West Indies.
	Years.	Years.	Years.	Years.	Years.	Years.
20	43·40	39·48	37·02	24·04	17·70	—
25	39·93	36·12	34·40	22·30	17·78	—
30	36·45	32·76	31·92	20·81	17·08	—
35	32·90	29·40	29·29	19·38	16·20	—
40	29·29	26·06	26·56	17·97	15·42	22·29
45	25·65	22·76	23·82	16·59	15·07	20·08
50	22·03	19·54	21·11	15·12	14·32	17·85
55	18·49	16·45	18·59	13·24	13·20	15·29
60	15·06	13·53	16·04	10·88	11·63	12·79
65	12·00	10·82	13·21	8·55	9·59	10·35
70	9·37	8·45	10·31	6·73	8·33	8·16
75	7·15	6·49	7·58	—	6·50	6·40
80	5·37	4·93	5·29	—	4·95	5·04

Formula : $\frac{L_x}{l_x} - \cdot 5 =$ the *mean after lifetime* at the age x. This is sometimes called the *expectation of life—vie moyenne*—or *mean duration of life.*

NOTE.—The mean after lifetime of Soldiers in India and of Pensioners in East and West Indies is deduced from the two Life Tables (Tables 12 and 15). For the Madras Civil Service it is deduced from a Table given by Mr. Neison on page 9 of his "Report on the Madras Civil Fund."

The Table may be read thus :—The mean after lifetime of a male aged 20 would be, in the Healthy Districts, 43·40 years ; in All England, 39·40 years ; in the Madras Civil Service, 37·02 years ; and for Soldiers in India, 17·70 years. At age 40 the mean after lifetime is 29·29 years in Healthy Districts ; 26·06, in All England ; 26·56, in the Madras Civil Service ; 22·29 amongst Pensioners who have served in East and West Indies ; and 15·42 amongst Soldiers in India.

At age 60 the members of the Madras Civil Service have the advantage of 1 year in their mean after lifetime over the males in the Healthy Districts, and of 2½ years over the males of All England.

TABLE 23.—ANNUAL PREMIUM which will insure £100, over the whole Term of the Life of a MALE aged x in ENGLAND and in INDIA (the latter deduced from the Life Table for the English Soldier in India).

Age. (x)	3 per Cent.						5 per Cent.					
	England.			India.			England.			India.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
20	1	12	5	5	3	5	1	6	2	5	0	10
25	1	16	7	5	0	9	1	9	10	4	16	11
30	2	1	8	5	4	9	1	14	4	5	0	8
35	2	8	1	5	10	6	2	0	2	5	6	5
40	2	16	2	5	16	1	2	7	9	5	12	0
45	3	6	8	5	16	9	2	17	9	5	11	7
50	4	0	5	6	1	3	3	11	0	5	14	10
55	4	18	6	6	10	7	4	8	8	6	2	10
60	6	3	3	7	8	4	5	13	1	6	19	6
65	7	17	7	9	2	1	7	7	3	8	13	7
70	10	4	7	10	8	5	9	14	1	9	18	0
75	13	7	3	13	7	6	12	16	6	12	18	1
80	17	8	4	17	8	3	16	17	1	17	10	2

Single premium to insure 100*l.* payable at the death of a male aged 20 in England and in India.

		3 per cent. £	s.	d.	5 per cent. £	s.	d.
Age 20	England	35	14	11	21	11	2
	India	63	19	6	51	8	8

Formulas:—

$\pi^x = a^x - d$ = annual life premium to insure 1*l.* payable at the end of the year in which death takes place.

$\Pi^x = 1 - d\,A^x$ = single premium to insure 1*l.* payable at the death of the insured.

TABLE 24.—ANNUAL PREMIUM which will insure £100 over the WHOLE TERM of LIFE of a MALE aged x, in ENGLAND and in INDIA (*expressed according to the Decimal System*).

Age. (x)	3 per Cent.						5 per Cent.					
	England.			Soldiers in India.			England.			Soldiers in India.		
	£	fl.	mils.	£	fl.	mils.	£	fl.	mils.	£	fl.	mils.
20	1	6	20	5	1	71	1	3	09	5	0	42
25	1	8	29	5	0	36	1	4	91	4	8	44
30	2	0	84	5	2	37	1	7	18	5	0	32
35	2	4	04	5	5	26	2	0	10	5	3	19
40	2	8	10	5	8	05	2	3	89	5	6	01
45	3	3	33	5	8	36	2	8	87	5	5	79
50	4	0	20	6	0	64	3	5	50	5	7	42
55	4	9	26	6	5	30	4	4	35	6	1	43
60	6	1	64	7	4	18	5	6	56	6	9	75
65	7	8	80	9	1	06	7	3	63	8	6	79
70	10	2	28	10	4	20	9	7	04	9	9	01
75	13	3	62	13	3	74	12	8	26	12	9	06
80	17	4	16	17	4	12	16	8	55	17	5	10

This Table may be read thus :—The rate of premium on a life aged 20 is 1*l.* 6 florins 20 mils. in England, and 5*l.* 1 fl. 71 mils. in India. *The latter may be read as* 51·71 *rupees.*

TABLE 24*a*.

The following are the INDIAN PREMIUMS charged by the ALBERT and MEDICAL INSURANCE OFFICE.

Age.	Without Profits.	
	Civil.	Military.
	£ *s.* *d.*	£ *s.* *d.*
20	3 0 9	3 10 0
30	3 12 0	4 0 0
40	4 10 0	4 14 0
50	5 18 0	6 2 0
60	8 6 0	8 10 0

TABLE 25.—PRESENT VALUE of an ANNUITY of £1 on the Life of a MALE aged x in ENGLAND and in INDIA.

Age. (x)	3 per Cent.		5 per Cent.	
	England.	Soldiers in India.	England.	Soldiers in India.
20	22·06	12·37	16·47	10·20
25	21·09	12·58	15·99	10·41
30	20·01	12·27	15·43	10·21
35	18·81	11·85	14·77	9·92
40	17·47	11·47	13·98	9·65
45	16·01	11·43	13·07	9·67
50	14·42	11·14	12·03	9·52
55	12·76	10·59	10·87	9·17
60	11·02	9·68	9·60	8·52
65	9·27	8·32	8·25	7·44
70	7·61	7·50	6·91	6·82
75	6·14	6·14	5·69	5·66
80	4·92	4·92	4·63	4·49

TABLE 26.—COMPARATIVE ANNUAL PER-CENTAGE of MORTALITY of the OFFICERS of the THREE ARMIES of BENGAL, MADRAS, and BOMBAY.*

PRESIDENCY.	Colonels.	Lieut.-Colonels.	Majors.	Captains.	Lieutenants.	Cornets and Ensigns.	Surgeons.	Assistant Surgeons.	Total or General Per-centage.	General Average.
Bengal - - - - -	5·94	4·84	4·10	3·45	2·75	2·34	- -	- -	3·12	3·85
Madras - - - - -	5·40	6·11	5·42	5·02	4·17	3·80	4·68	4·31	4·49	
Bombay - - - - -	5·74	5·45	3·77	3·78	3·96	3·15	4·08	4·21	3·94	
Mean age at death of Bengal Officers -	61	51	40	36	18 to 33					

* Asiatic Researches, vol. 20, p. 201.

TABLE 27.—TABLE of GOVERNORS-GENERAL of INDIA, showing at the Date of assuming the Government the Number of Years they were expected to live by the English Life Table, and the Number of Years they actually enjoyed. Their Years of expected Lifetime were 295 Years; they actually enjoyed 286 Years, and adding *nine*, the expectation of the surviving Governor-General, this also amounts to 295 Years. The mean Lifetime on assuming the Government was 21 Years by the Table; or the average number of Years which they afterwards actually enjoyed.

GOVERNORS-GENERAL.	Born.	Assumed the Government.	Quitted the Government.	Died.	Years of Lifetime after assuming Government.		
					Expected.	Enjoyed.	Difference.
Warren Hastings* - - -	Dec. 6, 1732	April 13, 1772	Feb. 1, 1785	Aug. 22, 1818	27	46	+19
Lord Cornwallis - - -	Dec. 31, 1738	Sept. 12, 1786	Oct. 28, 1793	Oct. 5, 1805	21	19	— 2
Lord Teignmouth (Shore) - -	Oct. 8, 1751	Oct. 28, 1793	Mar. 12, 1798	Feb. 14, 1834	25	40	+15
Marquis Wellesley (Mornington) -	June 20, 1760	May 17, 1798	July 30, 1805	Sept. 26, 1842	28	44	+16
Lord Minto - - - -	April 23, 1751	July 31, 1807	Oct. 4, 1813	June 21, 1814	16	6	−10
Marquis of Hastings (Moira) -	Dec. 7, 1754	Oct. 4, 1813	Jan. 9, 1823	Nov. 28, 1826	15	13	— 2
Lord Amherst - - -	Jan. 7, 1773	Aug. 1, 1823	Mar. 10, 1828	1857	20	34	+14
Lord Wm. Bentinck - - -	Sept. 1, 1774	July 14, 1828	Mar. 20, 1835	June 17, 1839	18	10	— 8
Lord Metcalfe† - - -	Jan. 30, 1785	Mar. 20, 1835	Mar. 4, 1836	Sept. 5, 1846	20	11	— 9
Lord Auckland - - -	Aug. 25, 1784	Mar. 4, 1836	Feb. 28, 1842	1849	19	13	— 6
Earl of Ellenborough - -	Sept. 8, 1790	Feb. 28, 1842	June 15, 1844	(living 1863)	19	20	+ 1
Viscount Hardinge - - -	Mar. 30, 1785	July 23, 1844	Jan. 12, 1848	1856	14	12	— 2
Marquis of Dalhousie - -	April 22, 1812	Jan. 12, 1848	1856	1860	29	12	−17
Earl Canning - - -	Dec. 14, 1812	1856	1861	1862	24	6	−18

* Warren Hastings first went to India in 1750, after which he lived 68 years.

† Lord Metcalfe arrived at Calcutta on January 30th, 1801, nearly 16 years of age, when his expected lifetime at that age was 42. He lived in India 35 years, and 10 years longer in England, Jamaica, and Canada.

TABLE 28.—COMPARATIVE TABLE showing the SICKNESS, MORTALITY, and INVALIDING in the EAST INDIA COMPANY'S TROOPS (Natives and Europeans) in each of the Presidencies during the Years 1825–1844.*

Presidency.	Europeans or Natives.	Years of Life, or aggregate Strength (1825–44).	Admissions into Hospitals during the Years 1825–44.	Deaths from all Causes.	Deaths from Cholera.	Invalids.	Ratio per Cent. of ordinary Deaths to Strength.	Ratio per Cent. of Cholera Deaths to Strength.	Ratio per Cent. of Total Deaths to Strength.	Ratio per Cent. of Number invalided.
Total of three Presidencies - - -	Europeans	240,577	382,600	13,012	1,741	6,939	4·685	0·724	5·409	2·884
	Natives -	3,881,660	2,591,107	69,973	13,260	75,077	1·461	0·342	1·803	1·934
Madras - - -	Europeans	101,210	135,720	3,892	432	2,101	3·419	0·427	3·846	2·076
	Natives -	1,196,260	904,325	25,064	6,976	23,479	1·512	0·583	2·095	1·963
Bombay - - -	Europeans	50,987	88,720	2,589	288	1,611	4·513	0·565	5·078	3·160
	Natives -	638,975	586,047	8,251	1,796	21,155	1·010	0·281	1·291	3·311
Bengal - - -	Europeans	88,380	158,160	6,531	1,021	3,227	6·230	1·150	7·380	3·600
	Natives -	2,046,425	1,100,735	36,658	4,488	30,443	1·570	0·220	1·790	1·500

* Paper by Colonel Sykes in the Statistical Journal, vol. x., p. 100.

TABLE 29.—CONJUGAL CONDITION of BRITISH-BORN SUBJECTS in INDIA.—Proportion per Cent. of Married, Unmarried, and Widowers, at each Age.

Ages.	Royal Troops.						East India Company's Troops.			Civilians and Civil Population.		
	Officers.			Soldiers.								
	Married.	Unmarried.	Widowers.	Married.	Unmarried.	Widowers.	Married.	Unmarried.	Widowers.	Married.	Unmarried.	Widowers.
Total of 20 and upwards.	19·2	77·5	3·3	6·5	93·0	·5	28·8	69·3	1·9	45·4	50·1	4·5
20— - -	2·8	97·2	—	1·7	98·2	·1	5·1	94·9	—	12·7	86·9	·4
25— - -	13·0	86·1	·9	6·9	92·7	·4	19·2	79·7	1·1	31·8	66·7	1·5
30— - -	29·2	69·2	1·6	15·7	83·0	1·3	36·9	61·5	1·6	51·8	44·6	3·6
35— - -	42·5	50·2	7·3	21·9	75·1	3·0	53·2	43·5	3·3	66·1	29·2	4·7
40— - -	49·2	39·9	10·9	18·9	75·9	5·2	71·9	24·1	4·0	70·5	21·7	7·8
45— - -	55·2	27·6	17·2	10·7	75·0	14·3	77·5	14·5	8·0	72·3	18·0	9·7
50— - -	55·9	20·6	23·5	—	—	—	72·3	13·7	14·0	73·8	14·1	12·1
55— - -	53·8	23·1	23·1	—	—	—	88·1	4·8	7·1	71·9	13·2	14·9
60— - -	66·7	33·3	—	—	—	—	79·5	7·7	12·8	72·8	10·2	17·0
65— - -	33·3	44·5	22·2	—	—	—	73·7	10·5	15·8	72·5	6·9	20·6
70— - -	—	—	—	—	—	—	100·0	—	—	61·8	2·9	35·3
75 and upwards	—	—	—	—	—	—	—	—	100·0	58·3	12·5	29·2

NOTE.—The Table may be read :—of 100 officers 20 and under the age of 25, there were 2·8 married, 97·2 unmarried.

TABLE 30.—ANNUAL RATE of MORTALITY amongst CHILDREN in INDIA and in ENGLAND.

Ages.	Children of English Officers in India.* (Facts supplied by Major-General Hanyngton.)			Annual Rate of Mortality per Cent. amongst Children of English Officers in Madras.* (Facts supplied by Mr. Samuel Brown.)		Annual Rate of Mortality per Cent.	
	Years of Life.	Deaths.	Annual Rate of Mortality per Cent.	Boys.	Girls.	Healthy Districts.	England.
Under 5 years -	21,019	1,384	6·585	3·589	3·604	4·036	6·738
5 and under 10 -	11,424	72	·630	·530	·568	·688	·916
10 „ 15 -	6,682	40	·599	·234	·319	·431	·527

* Many of the children proceed to England at about the age of five years.

TABLE 31.—MORTALITY amongst 2,993 SONS of OFFICERS in the Madras Army, from 1808 to 1857 inclusive, including 749 who became Annuitants.

Ages.	Years of Life.	Deaths.	Mortality per Cent.
0	1,399	134	9·578
1	2,618	152	5·806
2	2,425	56	2·311
3	2,292	32	1·396
4	2,188	18	·823
5–10	9,426	50	·530
10–15	7,272	17	·234
15–21	5,968	39	·654
Total -	33,602	498	1·482

TABLE 32.—MORTALITY from 1808 to 1857, amongst 2,884 DAUGHTERS of OFFICERS in the Madras Army, including 774 who became Annuitants.

Ages.	Years of Life.	Deaths.	Mortality per Cent.
0	1,348	110	8·160
1	2,305	137	5·943
2	2,325	62	2·667
3	2,187	32	1·463
4	2,074	28	1·350
5	8,975	51	·568
10	6,899	22	·319
15	4,879	27	·353
20	2,294	16	·697
25	1,004	6	·598
30	510	2	·392
35	279	2	·717
40	163	1	·613
45	84	1	1·190
50	36	1	2·777
55	15	1	6·666

ABSTRACT

OF THE

MORE IMPORTANT PRACTICAL POINTS

IN THE

MINUTES OF EVIDENCE TAKEN BEFORE THE COMMISSIONERS APPOINTED TO INQUIRE

INTO

THE SANITARY STATE OF THE ARMY IN INDIA.

Sir R. Martin, C.B., F.R.S.

Sir RANALD MARTIN, C.B., F.R.S., Physician to the Council of India.

SELECTION OF STATIONS. Questions 1 to 9.

Has been 22 years in India. Has served with Queen's, Indian, and native troops, chiefly in Lower Bengal, Orissa and Gondwana, Hyderabad in the Deccan, and in Burmah ; is very well acquainted with the stations throughout India statistically and topographically. They have been selected generally without care, the structural arrangements as to barracks and hospitals are very deficient, and many of them have been abandoned on account of their unhealthiness, he believes that many more must be so abandoned. No station which he has ever visited in India was exempt from malarious influences perceptibly detrimental to the European troops in occupation. A damp soil and a low situation, ill drained, with an irregular surface retaining the water in saucers, spread throughout the cantonments, and generally in low jungly ground ; some of them are subject to flooding.

DRAINAGE. 10 to 13.

Generally speaking there has been a great neglect with regard to latrines, urinals, ablution houses, and the means of removing their contents to a distance. The drainage of the stations was almost universally insufficient for the purposes of health.

WATER SUPPLY. 14 to 18.

The water is generally supplied by tanks and from rivers. The utmost care should be exercised in choosing pure water and in storing it so as to prevent decomposition. Iron pipes are preferable for conveying water to barracks and hospitals. Water is usually carried by hand carriage ; that is the system throughout India generally ; it is done by the natives. The water is always stored in tanks, but the tanks have been very much neglected.

CONSTRUCTION OF BARRACKS. 19 to 35.

Both the structure and arrangements of barracks are defective almost universally, except in the very newest barracks ; and there only with regard to the cubic space of air allowed per man. This remark applies to both barracks and hospitals. At new stations officers

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and men are sometimes hutted in a hurried and imperfect manner. The cubical space allowed varies infinitely ; there is no fixed standard. No barracks that he has seen have been constructed upon arches, which ought to be everywhere the universal principle ; neither has he ever seen in India a roof constructed as it ought to be, double. Has known the floors of barracks and hospitals continually damp, so as to render the ground floor unfit for occupation by Europeans. Has found a great difference in the health of the soldiers in different barracks which could be largely traced to the construction of the barracks.

The barracks are too often narrow, low, and confined. They are built generally of one story, sometimes two, and even of three. They generally have a verandah, occasionally all round, but generally to the east and west. They never have double walls nor a double roof.

Has known a verandah used as sleeping accommodation when the hospitals have been overcrowded. It is really a question of whether it may not sometimes be a benefit to the men, as compared with their being in the overcrowded inside ; but still it is an undue exposure of the men, and ought never to be done. There is no established rule as to the area per man on the floors.

VENTILATION. 39 to 42.

Natural ventilation is always used in the barracks. There is no fixed plan as to the window or door construction. The punka is generally employed. It removes from around the body of a sleeping soldier, or a sick soldier, as the case may be, the stagnant air which is apt to become corrupted. There are also wetted tatties, which are used during the hot winds, for cooling by evaporation. The windows are generally provided with jalousies.

ABLUTION ACCOMMODATION. 48.

The means of cleanliness are not provided in any organized and systematic way ; water is provided through native agency.

BAZAARS. 52, 53.

With regard to the means provided for cleansing and draining the bazaars, they are quite as deficient as for the stations of which they form a part. Systematic arrangements under a medical police are required.

RATION. 55.

The ration contained a sufficient quantity of animal and vegetable matter, good bread, and generally good meat, in his time, so as to give satisfaction to the soldier and to his officers.

INTEMPERANCE. 64 to 70.

A spirit ration is issued to the soldiers in India, or they are allowed to have it at the canteen, which amounts to the same thing ; in the field it is issued. Restrictions on the sale of spirits to soldiers in the bazaars are always attempted ; but the evil of open cantonments throughout India is the difficulty of maintaining a proper system of medical police, especially in regard to the use of the pernicious bazaar spirits. Thinks, with respect to the young soldier, the use of spirits is very injurious, and that beer or porter would be far preferable, and, indeed, the same rule applies to the older soldiers. On the march the soldier can get no dram ration but what is issued to him, and does not think that that is injurious. Malt liquor he conceives to be the best drink, and the free issue of tea and coffee is highly desirable. Tea, coffee, and cocoa are issued as part of the ration.

DRILL, &c. 71.

With respect to the drill the regulations are generally good throughout India, and are pretty uniform ; but with regard to exercises and amusements they still depend too much upon the locality and upon the general officer commanding a division ; these matters should be systematically arranged, for they are matters of great importance.

WORK AND RECREATION. 73, 74.

The means of recreation in India are generally deficient, and too much dependent upon the will of persons. In some regiments knows that indoor amusements have been carried to a very great and beneficial extent, and the prosecution of the trades of the men encouraged for their own benefit. In the 3rd Bombay Fusiliers there were remark-

able instances of improvement in the men's moral character; courts-martial and crimes diminished in proportion as the men were occupied for their own benefit. The opinion of some of the most celebrated of the army surgeons has been that it should be a principle to permit a soldier to do for himself whatever he can do without injury to his health or discipline, believes it is a sound principle. *Sir R. Martin, C.B., F.R.S.*

As regards under-clothing, the general opinion among army surgeons is that flannel is an essential part of a soldier's dress in the field. It is a question whether it is necessary for him in cantonments; but considering his reckless habits and well-known carelessness, believes that it will be a protection to him even in time of peace. Thinks also that a complete flannel dress, to be worn immediately on coming in from the march, would be of great use in preserving health. The evaporation from the surface of the body is so great in India, that it is necessary there should be a slow conducting material in the body dress of the soldier; cholera belts are superseded by flannel shirts, and properly so. The soldier should wear flannel night and day, for the diseases of India are in a large measure contracted by exposure during sleep. A soldier upon lying down and falling asleep in hot weather, and during the rains, in a state of profuse perspiration, suffers from a sudden change of wind or a cold gust from the mountains, and he rises with a shivering fit, and with acute inflammation of the liver, and a flannel shirt there would be a great protection. Dysentery and all the tropical diseases result from sudden chills and exposure. CLOTHING. 79 to 83.

A great majority of the old stations have been selected by the general officer of a division for the time being, aided by any person whom he might think it proper to consult. They have been selected rather with a view to convenience in a strategical point of view than with reference to the healthiness of the site; but chance had much to do with it. There were enormous invasions of epidemics, chiefly of cholera and fever, which infested certain stations at intervals of time. It has always been found that epidemics fasten most firmly upon and remain longest in the worst stations. That observation applies to cholera, fever, and dysentery, and has reference to questions of position, drainage, and malaria, in addition to the condition of the barracks and bazaars, and the overcrowding, and the want of cleanliness. A good deal would arise from the different habits of various regiments, more or less addicted to intemperance, night duties, and so on. Very much depends upon the individual character of the commander, which has ever been held amongst military surgeons to be of the utmost possible importance. Of all the causes that go to foster and maintain epidemics, the ill selection of localities, the structural defects as to ventilation, drainage, cleanliness, and the personal habits of the soldiers, are the important questions. A permanent result, as regards epidemics, is to be obtained only by placing every selected station in a position of defence, if I may so call it, against the invasion of epidemics, by the application of all known sanitary appliances, such as cleaning, draining, and levelling, having a supply of pure water, improved structural arrangements, especially with regard to ventilation, and good habits of life in the men, and proper space provided for them. There has been a great prevalence of liver disease almost everywhere, but more in particular stations. For instance, Bangalore, which, although a healthy station, is one that is obnoxious to that disease from the circumstance mentioned; but it is much more prevalent in Lower Bengal, for instance, than in the North-west provinces,—in the country of the great waters, the country of heat and malaria. The precautions taken against disease of the liver, in addition to being of CAUSES OF DISEASE. 88 to 134.

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a general sanitary nature, ought to be very particular with reference to personal hygiene. Liver disease and dysentery are continually associated with each other, so as to be a most marked point of observation with all medical officers in the East Indies especially. It presents itself as associated *ab initio* with dysentery; and it presents itself as a secondary circumstance in the form of abscess, either from purulent deposit in the liver, or from absorption from the ulcerated surface of the bowel. Rheumatism is chiefly caused by sudden alternations of temperature. There personal hygiene is necessary, and warm clothing. But there is another form of rheumatism, produced by the application of cold to the system while under the influence of mercury; a most detrimental form of disease, which causes the invaliding of a great number of men. There is an enormous extent of venereal disease in India. Police regulations were formerly enforced at the stations, and courses of inspection and locks were established, but they have been established and abolished, and established and abolished over and over again. It is in the same state of uncertainty that all the other sanitary arrangements are. Has generally observed that the liability to disease of the liver, as well as to all other diseases in India, has increased with the age of the soldier. Guinea-worm prevails very largely in the west of India, in the Bombay presidency, and in the central parts of India. It is often referred to the use of impure water. The improvement in the general health helps the cure, the use of cold water seems to paralyze the guinea-worm and to favour its extraction; under the influence of a jet of cold water has extracted several. Taking all the causes together which may be supposed to influence the health of the soldier in India, should say that the union of heat with malaria constitutes the most powerful one in destroying the integrity of the European soldier's health, and conducing to his fall by disease. That which is the most effective in injuring him is also the least remediable, excepting by the neutralizing effects to be obtained from purity of soil and purity of water, and improved structural arrangements in barracks and hospitals, and care in diet. These circumstances, where enforced carefully, go as far as can be to neutralize the effects; but a certain amount of destruction and deterioration of European health must result from a residence at the stations on the plains even if the soldiers were put into palaces. There is a certain amount of precaution which could be taken, which would have the effect of greatly reducing disease and mortality, particularly if, in aid of the arrangements suggested, the soldiers were periodically, should say annually, removed from the stations in the plains to selected stations on the mountains. There is a very great difference between the health of the officer and that of the private, always in favour of the officer. There is a difference between the health of the officer and the civilian, always in favour of the civilian. Both of those facts unquestionably tend to show that precaution has a very great effect in the result upon the climate.

HILL STATIONS. 138 to 158.

Unhappily the hill stations selected by the Government in India have often been in the front ranges of the mountains, receiving the brunt of the south-west monsoon; but at some distance in the rear of these foremost ranges, 40 or more miles farther back, the rain-fall is that of temperate regions, where the climate is comparatively dry and salubrious. The stations which have hitherto been occupied have been at a very considerable elevation, and thinks in that matter we have committed an error, by carrying the soldier to so great an elevation as 6,000, 7,000, and 8,000 feet; it is very certain that we have removed him from the foci of malaria, but it has too often happened that we have carried him into the focus of another class of disorders,

namely, bowel complaints. A great mistake has often been committed, namely, the removal of troops whose health has been damaged in the plains to the cold damp mountain ranges, which are only applicable to healthy men, and for the preservation of health. The mountains of India cannot be said to bear upon the cure of disease; they are not curative. Thinks that if troops soon after landing in India were placed in elevated positions which had been carefully selected and prepared for them beforehand, they would be maintained in a state of health and vigour, and they should descend into the plains only for the purposes of exercise in cold weather, and for the purposes of the march in order to perfect the lower and the upper extremities, and to improve the general health. On the plains no British soldier should remain longer than twelve months, and at the end of that time he should go for refreshment and invigoration to the nearest mountain station, taking him there by the end of February, or the beginning of March. As regards children, Dr. Burke, late Inspector-General of Hospitals, states that Fort William, Calcutta, is one of the worst, if not the very worst of the military stations in India for European children—the average annual mortality being above 160 per thousand. The Principal of the Lawrence Asylum says that the children of British soldiers in the plains die so early that only about one in five is found surviving the fifth year of Indian sojourn, while in the mountains they flourish like children in healthy English districts.

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All statistical observations go to disprove anything like acclimation in the East Indies. On the contrary, the disposition to disease and death increase by length of service and age. There is one thing which a soldier does acquire by a long residence in hot climates, namely, that the old soldier had learnt a certain amount of personal hygiene, which he imparts to the recruit when he joined, and that was considered to be especially the case with the artillery battalions. That would account for the better rates of disease and mortality in the Company's army, as compared with the Queen's troops, and conversely for the non-acquaintance of regiments with these traditional circumstances of precaution upon their arrival from England. No soldier should serve at all on the plains, excepting at such stations as had been carefully prepared beforehand, such as the Government considered necessary for political and military purposes. One of the great advantages to be derived from the occupation of the hill ranges, would be from the application of strict rules of medical police applied especially to prevent the introduction of spirits, and the impure intercourse of the sexes, which goes to increase the syphilitic and other venereal diseases to an enormous extent,—indeed, to an extent to injure the British army in India in an inconceivable manner, for the men are injured not only by the disease, but by the treatment they receive, so as to render them doubly susceptible of all tropical diseases. The mercurial treatment, even when mildly and moderately used, is most detrimental.

ACCLIMATIZATION. 159 to 163.

As regards hospitals, there is the same want of strict attention to ventilation as there is almost universally in England. The buildings are generally defective. The latrines and drains are deficient generally. There are ablutions; water is to be had generally, and is freely used by the native sweepers. The walls are whitewashed periodically.

HOSPITALS. 165 to 178.

No recruit at all should be sent to India, but every man should go out as a thoroughly drilled soldier, and the nearer he was to the age of 23 the better. Exempt them for the first year from any over-exertion of any kind where the circumstances of the service permitted it. The expense of the additional drill at home would be repaid by a

SERVICE IN INDIA. 182 to 213.

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smaller degree of disease and mortality in India; but that is a point that is hardly at all considered by the general mass of observers. It is a most important one, and it illustrates a truth of universal application, namely, that sanitary improvement, all over the world, more than repays its own expenses. As regards the voyage to India, the climate, which the soldier has to traverse from the shores of England to those of India, is about the finest in the world; it is neither too hot nor too cold, and provided sanitary circumstances are attended to during the voyage, such as ventilation and cleanliness, and a regular system of watch upon deck, the soldier ought to arrive in India in the finest possible health, going round by the Cape. The chief attention on board ship ought to be paid to ventilation, cleanliness, and diet. The diet has generally consisted too much of animal food, the salt ration in particular, and too little of vegetables and soft bread, which latter article ought never to be wanting to a soldier anywhere. They could have soft bread on board ship. The French have it. They bake it; and with the same attention on the part of our commissariat, it might be done. Lime juice is always supplied; but it ought never to be required. Generally throughout India the arrangements for the cure of disease are admirable, but they are not at all so for the prevention of disease; for this greatest purpose they are almost universally wanting. The men during their transport on the rivers are not exposed to any unhealthy influences excepting on landing: when they are on the water it is all very well provided, the accommodation on board is generally suitable. They obtain their water generally from the rivers, allowing the sandy particles to gravitate to the bottom of a vessel: when they land they usually have the benefit of tank water. There has been no systematic furlough at all for the European soldier. None but the officers got sick leave in his time. No system of sick leave has been established, until the other day, when non-commissioned officers were permitted to come home on furlough. It has been too much the custom in India, in chronic states of disease which follow upon acute tropical affections, to keep a soldier in hospital, or to send him to mountain ranges which were very unsuitable for him. Would dwell in the most emphatic manner upon the importance of every measure of prevention, so as to secure the utmost amount of health to the men consistently with the service in the country. It is the duty of the State to place the British soldier in the best climates to be found within our Eastern dominions. Of all the diseases on account of which men are invalided from India, by much the most prevalent is fever. Remittent and intermittent fevers are the great diseases: next in frequency and importance come the bowel complaints and dysenteries of India: after that diseases of the liver and cholera. These are the great divisions of tropical disease, and from their immediate results or from their remote consequences arise the sicknesses and deaths of European soldiers in India; and it is for the treatment of chronic affections, structural and organic affections, that some climate beyond the shores of India is necessary for the cure of a great number of our soldiers, and cures to be aided by a climate which India does not possess.

PAPER ON HILL STATIONS.

Puts in a paper containing a statement of his opinions on the subject of hill stations.

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In this paper Sir R. Martin shows—

1. That the altered condition of affairs in India since the mutiny has rendered more than ever necessary the introduction of a complete system of military hygiene, first in importance being the selection of hill stations for healthy troops:

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2. That it is questionable whether, with the present losses from all causes, equalling 120 per 1,000 per annum, it will be possible to maintain a large army in India :

3. That recruiting is not likely to increase :

4. That increased education and reading have influenced the mass of the people, and will add to the difficulties of finding recruits :

5. That recruiting will come to a standstill when the facts are known through the press :

6. That to avoid this result improvements must be introduced, hill stations selected, and every means taken to improve the health of the troops :

7. That troops should be brought down from the hills every cold season for marching and drill :

8. That better feelings and a general disarming of the population may enable troops to be dispensed with in unhealthy positions :

9. That European troops be only employed in duties which cannot be otherwise done :

10. That the greatest political advantages would arise from locating the bulk of our troops on hill stations :

11. That at Jamaica the use of a hill station had been followed by a reduction of the annual death rate among troops from 130 per 1,000 to 22 per 1,000 : that it cannot be necessary to retain so large a body of troops as is proposed on the plains of India :

12. That India has greater natural advantages in hill stations than the West Indies :

13. That the climate, and not enemies, is to be feared in India :

14. That no hill station should be occupied permanently until it has been tried :

15. Medical police is of more importance in Indian climates than at home, on account of the more rapid progress of disease, but the selection of hill stations would facilitate the exclusion of at least two of the greatest banes of cantonment life, bazaar spirits and syphilis :

16. At a hill station a few sentries would guard against these great evils, but no number of sentries would be sufficient on the plains :

17. That sending sickly regiments to the hills, and constructing barracks and hospitals there without due consideration and trial, has led to disparagement of hill stations. The mountain ranges are only useful for preserving health :

18. That the climates of Western Australia be used for sick soldiers :

19. Climates in India, whether on plains or mountains, aggravate rather than cure chronic visceral diseases following on acute affections :

20. Hence the necessity of a foreign climate out of India, which presents greater advantages than those of Europe :

21. From all accounts such a climate exists in Western Australia :

22. The sanitary precautions required for the Indian army are—1, careful selection of stations which must be held on the plains, with provision of every sanitary appliance ; 2, occupation of table lands for artillery and cavalry ; 3, hill stations for preserving health ; 4, convalescent stations beyond sea for invalids.

23. A sanitary service distinct from the army medical service should be organized for all purposes except for personal hygiene of the troops :

24. Additional evidence of the injury inflicted by service on the plains is afforded by the short average periods of service of men admitted to pension and of men discharged unpensioned from the Company's service, namely, 15 years 10½ months for the former, and 8 years and 6 months for the latter.

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SANITARY SERVICE. 216 to 224.

No knowledge of sanitary science is exacted from Indian medical officers. The medical department in India is well ordered for all the purposes of cure, but the sanitary department is altogether wanting in it. No steps are taken after the examination of medical officers, and after they have come from the medical schools, to impart to them any peculiar knowledge. All their knowledge of sanitary science must arise from the future course of the service, and too often at the expense of the soldier. The school established with a view to compensate for this deficiency in the Queen's army, is the greatest boon quoad the medical department of the army that has ever been granted.

Col. William Swatman.

Colonel WILLIAM SWATMAN, Bengal Army.

Has served in India since the year 1828 in the infantry, at Barrackpore, Agra, Gwalior, Mhow, Cawnpore, Dinapore, Mogulpore, Dacca, Chittagong, Chinsurah, and again at Agra; also at Lahore and Peshawur.

BARRACK CONSTRUCTION. 291 to 311.

The present Indian barracks are on a new construction, and they are admirable; of the old ones, some of them are very good, and others are of a most inferior description, quickly run up in order to accommodate troops who have been sent there for the first time. Considerable pains are now taken to secure ventilation; does not think it was so much so formerly. Ventilation is introduced both through the roof and wherever it can be gained, and through the doors and windows. Lime washing is very frequent; every day in the drains, and all places in which offensive odours can be generated, chloride of lime or quicklime is used. An officer in command of a station as well as a regiment is empowered to direct the barrack department to execute any immediate repairs to a limited extent; beyond that he must refer to the divisional authorities or to any chief authority within reach. As a rule, stations have been selected for military purposes not for health. Has always seen baths and plunge baths in barracks.

SANITARY CONDITION OF STATIONS. 325 to 415.

Barrackpore is considered unhealthy, but troops are kept there in order to cover Fort William; it is the nearest cantonment to it. Chinsurah is not more than 23 miles from it, and is considerably better. Agra is high and dry; the station could not improved by removing it to any neighbouring place. Cawnpore is notoriously unhealthy; can scarcely say why it is so; Dinapore could scarcely be called a healthy climate. The reason for selecting Dinapore as a station is, that there is an immense city, Patna, which it is requisite to keep in check. Doubtful whether there is any neighbouring place that would be better; Agra and Patna being large cities, that seems to have been the reason why the cantonments were placed in their immediate neighbourhood. All the externals of Boglipore would lead you to think that it was very healthy, but it did not prove so, and it was abandoned, and it is now no longer used as a cantonment. Dacca is an unhealthy place. The heat is not excessive, but it is very damp. Fever and ague are the great diseases there. The country subject to floodings. We always looked upon Dacca as the very focus of insurrection, surprised to find it infinitely quieter than could have been supposed when encouragement to insurrection was given. Chittagong is much healthier than Dacca, but it is subject to certain changes in its salubrity; for some years the native troops would be perfectly free from disease, and then they became unhealthy, which was supposed to result from the jungle, and the cantonment was cleared; has not heard with what result. It is a very disputed point whether clearing has an immediately good effect upon health; some hold that it absorbs the malaria, and some that it gives

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it out. Disease generally is observable where there are canals and irrigation; it is from the irrigation and the cultivation, as they produce fever almost invariably. Chinsurah was extremely healthy for a year and a half. It is a place almost entirely surrounded by water in the rains. It stands rather high itself, but still with innumerable hollows and ditches, and you would suppose that it would promise to be one of the worst possible stations. It has been extremely unhealthy, but we were extremely favoured in that respect. The supply of water at Agra is extremely bad; the water is brackish there, and there is but one well in the neighbourhood of the barrack that produces spring water. At the other stations water was obtained either from a river or from wells. The water which is furnished to the troops in India not considered at all wholesome water; it is not properly filtered. Lahore fort was very unhealthy indeed. The climate in cold weather approached to an European climate, but during the hot weather the heat was excessive. The fort was supposed to be very unhealthy, and it was in the neighbourhood of a city that was very filthy indeed. The fort was well drained; the water was indifferent. The barrack buildings were not good, they were confined; the troops were put into buildings which were never designed for such a purpose. Regiment so unhealthy that it was relieved, and sent into the neighbouring cantonment of Anarkullee, about a mile outside. That was a better station; and Meanmeer, which is four or five miles away, is more healthy still than the fort at Lahore. Its superior healthiness was due to its being removed from the influences, in the first place, of a dirty city. The country generally is subject to fevers, what was termed the Lahore fever—a very violent fever, remittent and intermittent too. Peshawur is in a fine northern climate; it has eight months of cool temperature, and four months of extremely trying heat. It forms the apex of a valley, and there was irrigation going on in the neighbourhood of the cantonment, which it was supposed gave out some malaria; the troops were very unhealthy there. There are four months in the year which are very trying from the heat, which acts upon the constitution almost at once; both officers and men suffered very much there; the men had very bad barracks there, but lately they have had very good new ones. For eight months, during which the heat did not prevail, the place was healthy. Such excessive care is required as to cleanliness of stations that it is now generally understood, and is improving every day. Now that attention has been directed to it, everybody who is responsible looks to these matters. The commanding officer is held responsible for such things, but he is controlled again by his superiors who visit the barracks, and again also, on the medical side, the superintending surgeon comes and inspects the premises repeatedly. The bazaars cause a great deal of trouble, but they are improving them, they occupy new sites, and they are better laid out. Each regiment has its bazaar, and it is immediately in the rear of the regiment. The cantonment is entirely open, and the bazaar is behind it. Sometimes in irregular stations any convenient spot has been chosen, without reference to its being in the front or in the rear. It is the quartermaster's duty to preserve the cleanliness of the bazaar, and the cantonment magistrate would look to it. It is the quartermaster's duty to look to the slaughter-house, but the slaughtering of the cattle is with the commissariat. The cantonment carts go through the stations and remove all horse manure. At some of the stations it is carried out to the fields as manure, or to some neighbouring pits. Formerly sufficient precautions might not have been taken, but everybody looks to this matter now.

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WATER SUPPLY. 416 to 421.

Water is raised either by a leather bag and a rope, or else by a leather bag attached over a pulley by bullocks. The water-carriers bring it to the barracks and deposit it in earthen jars which are kept for that purpose. Water pipes are never used. At Peshawur there is a running stream directed through the cantonment; the river is dammed, and small channels are diverted through the whole of the cantonment. It is a healthy practice, except that irrigation takes place to the gardens from it. In the whole of the cantonments the supply of water at Peshawur is from these channels.

RATION. 422 to 438.

The soldier's ration in India is good. The Government ration is supposed to be sufficient for a man, but for growing youths not; they purchased in my regiment extra meat, and they were then drawing a pound a day. We found that they were not sufficiently fed, being in a damp climate, and the experience of the old regiments taught us that it was better that they should be better fed. The pound of meat is supplied with bone from the commissariat, the upper part of the rib bones being cut off. Tea and coffee were issued as part of the ration, also rice; and if they did not procure bread, a larger quantity was allowed, salt and sugar, and vegetables, either potatoes or onions. It was a very good and sufficient ration. It costs three and a half annas a day. No change necessary in the ration. The men have three meals a day, breakfast, dinner, and tea. They cook in messes. Coffee sellers early in the morning are admitted to the barrack at gun fire, and a man can buy coffee at his option; it is sold at a small price, and many of the men adopt that practice.

INTEMPERANCE. 440 to 466.

Beer and porter are issued to the men. It is purchased at the bar of the canteen. Spirits are not issued, they are sold. Not allowed in the bazaar. Whenever it can be done, the restriction is evaded. At the canteen sometimes one dram only is allowed, and sometimes two, according to the regulations. Spirits are forbidden to be sold in the bazaar, and if the bazaar seller is caught at it very heavy fines are inflicted upon him. One would like to see the sale of spirits in canteens abolished altogether; but it appears to be necessary to many men, and it is much better that they should purchase wholesome Government liquor than the trash which is procured in the bazaars; but the men obtain bazaar spirits surreptitiously. Natives frequently use spirits themselves. The Government are somewhat to blame; for there are men who hold a licence to sell spirits, provided that it is not sold to Europeans, but that is how it would come into the hands of Europeans. The soldiers drink beer, but not to a large extent; not so much, perhaps, as you might wish. Some beer is made in the hill stations, near Simla, it is very good, but it will not keep; it is a light, palatable, good beer; the hot weather destroys it; during the cold weather it is perfectly good. The beer exported from England keeps well. Of course you have the power to suppress the sale of spirits in cantonments, but you would drive the men to worse. The habits of soldiers in India, with regard to drink, have improved.

OCCUPATION AND RECREATION. 468 to 483.

The ordinary games are fives and rackets, skittles, and quoits also; long bowls is a very favourite amusement of the soldier. They have Government libraries and books. They read all the light works with avidity. Lately they have attended the schools better than they did formerly, because promotion is a good deal dependent upon their ability to read and to write; their children are sent to school compulsorily. Attempts have been made to provide the soldiers with gardens at some stations, they ought to answer, almost all the European vegetables grow well. Is sorry to say that

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there are no workshops in which they can carry on trades; they might be introduced with the greatest benefit; they would be a source of profit as well as of amusement. The only difficulty is in furnishing the materials at first. The workshop ought to be self-supporting after that. The soldiers are entirely idle; but an establishment of that kind would encourage them to do more than they do. The men in cantonments lead a wearisome life; knows of no better outlet for their ennui than workshops; but it would be necessary for the Government to lend out materials in the first instance.

DRESS. 487 to 489.

There has been a good deal of change and great improvements in the matter of dress, as far as efficiency goes, and comfort. The adoption of the tunic instead of the tail coat; the head dress is lighter too. A helmet has been substituted.

DUTIES. 495 to 501.

The soldier commences his day at gun fire, probably about five in the morning, and then he begins his parade, which may last an hour and a half; after that he takes his breakfast; probably he will get a bath between the parade and his breakfast. After breakfast he is a wanderer, if he chooses to go out. The cleaning of his arms and accoutrements takes up some of his time. In warm weather he is very often restricted to the barrack till late in the afternoon, but the soldier has his recreation, if the weather will admit of it, out of doors or in the skittle-grounds, which are generally covered. There is no roll call during the night, unless the men have been showing any indications of a desire to get out. They have two hours sentry duty. Ordinarily in the course of 15 or 20 days a man will have but one night guard.

SANITARY DUTIES. 518 to 535.

With reference to sanitary duties the medical officer, in case of ill health among the troops, would at once represent any want to his commanding officer, and also to his medical superior, the superintending surgeon. He could only suggest them to others. If there were any immediate means of removing the defect, the commanding officer would not mind taking the responsibility upon himself, referring it as a matter of course to the higher authorities. This could be done by the military authorities so long as it is within the confines of the military cantonment; but if the defect affected the cultivators, you must necessarily go to the civil authorities outside. Such a thing as the construction of a large drain would go in the general routine of representation. Small repairs would be done as a matter of course upon the authority of a station order. There is nothing to oblige a commanding officer to carry out any recommendation that is made to him; but he would be very deficient in judgment if he failed to take a hint of that kind. The surgeon has another outlet under his superintending surgeon, who is entirely independent of the commanding officer; he would report to him directly. In other cases, such as the hour at which troops should be brought out in the conduct of a march, and the selection of the places at which they should halt, has always consulted the surgeon of his own regiment. It is the common practice to do so. It may or may not be done by order. The men suffer extremely from venereal disease. Everything is done that can be done to check it. In the station of Peshawur, the cantonment magistrate was very active on those points, and he established a systematic supervision of those women through a senior matron; he took her into the public pay, and insisted that before a prostitute should be suffered to enter the lines of the cantonment, she should register herself as willing to be overlooked by this person, and that was considered to be a great check upon disease. Any woman who was notoriously diseased, and had not been under that matron's examination, would have been subjected to punishment, and liable to be

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turned out of the cantonment; but it was done there on a systematic scale, which is not always possible. At Chinsurah disease was rife. The only check that he could interpose was to make men admitted into hospital for the disease bring up their duties. That was out of justice to the other men, as well as an example to themselves.

CHANGE OF STATION. 541 to 544.

Frequent changes of station are healthful; people on the march are generally marked with every appearance of strong health,—men, women, and children. Regular exercise is conducive to health. The influence of change is very often remarked; even going to a worse station has produced a check upon ague. Inclines to a stay of three years at a station, because there are so many other considerations to be taken into account, as, for instance, the expense of removing.

PERIOD OF SERVICE. 550 to 569.

The time during which a soldier remains efficient in India is entirely dependent upon his own constitution in the first instance, and upon his temperance. The officers do not suffer so much as the men. They live with more care, expose themselves less, and they occupy better quarters. The practice with regard to furloughs to officers is, that they can return to England after 10 years' service for one furlough of two years, and after 20 years' service for a second furlough of two years. The men have no furlough; they stay until they are invalided, except being sent to the convalescent depôts in the hills. If the men had workshops there and gardens, and had their families around them, that would be a great advantage in the hill stations. But the difficulty is to find space, for they cannot take advantage of the fine climate there and walk as they would do in the plains.

Dr. Duncan Stewart.

Dr. DUNCAN STEWART, Surgeon to the Depôt at Warley.

RECRUITING. 598 to 623.

The recruiting age for India is between 20 and 25, but there are different ages for the different arms, cavalry and infantry; it is between 20 and 30 and from 20 to 35, but a great many pass into the service who are not 20. The depôt at Warley is the only one in England for East India recruits. The recruits do not enlist for particular regiments, but for particular arms of the Indian service, viz., for cavalry, infantry, or artillery. Transfers from one arm to another sometimes take place after their arrival at the depot. The average per-centage of sick to strength is 6·50. The average number of men in hospital is 40, and of these rather more than one-half are venereal cases. The common diseases are rheumatism, sore throats, and scarlet fever. No better or healthier men (for their age and size) could be found in Europe than the recruits who have embarked for India during the last two years from Warley depôt. The age and height fixed for the Indian recruits are—for artillery, under five feet six inches from 20 to 25 years, five feet six inches and upwards from 20 to 30 years of age; for cavalry, five feet three inches and upwards, not under 20 nor above 30 years of age. There is no fixed time for drill or training. The average time passed at the depôt before 1857 was four months; it is now less than six weeks. Has known men embarked the same day they joined the depôt. Undoubtedly the route to India by the Cape is preferable for recruits. Believes the arrangements for the accommodation, the diet, and the exercise of the men during the voyage to be excellent. Cannot see any advantage in placing men in depôt at an intermediate station. It would be far better for a healthy man to go out direct, if he is properly taken care of when he arrives, rather than stopping on the way. Does not think that acclimatization, as generally understood, confers any immunity from tropical

disease. Young men are more subject to acute diseases than old. Generally speaking, before the insurrection in India the men were thoroughly drilled before they were embarked. *Col. William Swatman.*

ARCHIBALD STEWART, Esq., Deputy Inspector-General of Hospitals. *Archibald Stewart, Esq.*

Has served at Cawnpore, Umballa, Ferozepore, Lahore, and Meerut, Kirkee, and in Central India. Cawnpore is a tolerably healthy station in the cold months; there are dry hot winds in the hot months. The soil is light and sandy. The country is flat, and the station is about a quarter of a mile from the Ganges, left bank is liable to be overflown during the rains. In the rains, and immediately after, the station is very unhealthy. At the time referred to the sanitary arrangements at Cawnpore were extremely imperfect. During the rains the water is apt to lodge on the plain where the dragoon hospital stood, and the draining was not what it might be made. There is a good deal of broken ground in the neighbourhood of the bazaars, and the sanitary measures taken, as regards those localities, were very often imperfect; natives frequently retired there, and there used to be, generally speaking, no proper police to maintain cleanliness. The subsoil is sand mixed with clay and masses of "kunkar." The latrines were in the neighbourhood of the barracks, and they were sometimes exceedingly offensive. Latrines are often in unpleasant proximity to the cook houses. There is, generally, a want of urinaries a little way off the rooms. The latrines have seats, made of masonry, or burnt brick covered with chunam or lime plaster. The soil runs into a common receptacle outside, which is often concealed by a screen wall. The masonry becomes highly impregnated with urine, and the latrines are often exceedingly offensive. In the Bombay Presidency there are iron pans, removed and emptied when necessary. These latrines are more easily kept clean, and generally less offensive, than in the North-west Provinces. The soil is carried away by carts at night. The barracks at Cawnpore were eight in number. They were placed with the broad sides to the north-west and south-east, or to the east and west, the ends being north and south. Their order was parallel, with an interval of about 50 or 60 yards between each. There were no proper separate quarters for married men and their families. The arrangement was objectionable, because the one barrack sheltered the other, and the space between them being so limited, excluded the others more or less from the influence of the most favourable winds, especially in the hot season. SANITARY CONDITION OF STATIONS. 633 to 656.

No barracks ought to exist in the North-west Provinces except in echelon, so as to ensure the full advantage of the barrack being rendered cool and comfortable for the men. All the barracks that he has seen in Bengal have been barracks with a single story. With no circulation of air under the floors they are raised, from a foot to two feet, on a basement. It is most important that barracks should be raised three or four feet at least from the ground, and the more flat the locality is the higher they ought to be. The basement ought to consist of solid material, constructed on elevated arches. Barracks in India, so far as he has seen, are generally overcrowded. Has almost uniformly observed that in those years in which circumstances happened to admit of improving the accommodation of the troops, together with arrangements calculated to add reasonably to their comfort, the number of admissions into hospital was less, as likewise the mortality, compared with preceding years. The barracks which were said to contain for each man 1,000 cubical feet were very similar to most of those he BARRACK AND HOSPITAL CONSTRUCTION. 658 to 761.

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has seen, perhaps better. The superficial area allotted to each man has generally been very small. Usually there is an inner central room in which the men sleep, and there is an enclosed verandah, and then an open outer verandah on each side of the central room. With but one exception, never saw what he considered to be really a good barrack, and that was at Meanmeer, Lahore. In the inner wall there is usually either an open doorway at the distance of every seven feet, or a doorway and window, low down, alternately at the same distance. These windows are not glazed as in England, being often either closed with ill-fitting shutters, or open. Two beds are placed in this space of seven feet, leaving only an interval of one foot between the two beds. The space of clear wall allowed for every two beds should not be less than 10 feet, thus affording to the occupants of the beds protection from strong direct currents of air through the open doorways and windows. At present men are liable to be injuriously exposed, by night and by day, and in all seasons, to strong direct currents of air from the doors and windows. Soldiers read a good deal. They obtain books, &c., from the library, and lie upon their beds and read during the day. From the faulty plan and construction of the buildings, men are compelled to pass much of their time under more or less constant exposure to direct currents of air, by night and by day, and in all seasons. Hence, rheumatism, pulmonic affections, dysentery, with other serious and too often fatal diseases, prevail at certain periods. The mode of ventilation usually existing in barrack rooms in India is far from salutary or even safe. The great desideratum is, buildings so planned and constructed as, together with other proper sanitary measures, to admit of the establishment of a free, sanitary, and safe system of ventilation, under a judicious practical application of sound principles. The windows are not glazed as windows are in England, sometimes having only one or two panes fitted into the wooden plank or shutter ; at other times, as in the barracks at Kirkee, having no glass or opening at all in the shutters, so that when the latter are closed, during a storm or otherwise, light is altogether excluded. The men in hospital are exposed to the same evils as men in the barracks. Men sleep in the verandahs from necessity ; and when that happens the evil is in no way diminished, rather the reverse. From so many doors, and insufficient control over ventilation, the hospital is very often extremely uncomfortable for men, particularly those suffering under chronic dysentery, rheumatism, &c., in the cold months. In the hot months tatties are supplied to cool the air ; they are made of the roots of "kuskus" grass, put up against the doorways, and watered during the hot winds. The barracks at Meerut were very much of the same description as at Cawnpore ; they were arranged in a similar manner, one behind the other. The barracks were frequently complained of. It has been the custom in dragoon regiments to have the saddles, valises, bridles, and the different accoutrements of a dragoon, suspended in the room where the men sleep ; of course taking up a great deal of the space in the room ; they hang over the men's heads, in the space of seven feet, immediately over the beds. Has seen a man's saddle hung close by his ear, low down ; and the saddle itself being often foul from being saturated with the horse's perspiration, it tends to impede ventilation very much all round where the men sleep, and they breathe an impure atmosphere ; they breathe it over and over again, and that, too, in the very hot months when thorough ventilation is essential. Nowhere, and especially in India, ought the dragoon's saddlery to be allowed in the same sleeping apartment with himself ; it should be put into an apartment attached

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to each barrack, allotted for the express purpose of receiving the saddlery. Barracks constructed in separate houses are more healthy than others, and favourable to ventilation. In the hospitals there was no proper well-lighted apartment in which any medical committee might meet, or in which any important or delicate surgical operation might be performed—a defect from which most serious practical inconvenience has been experienced. It was necessary to take patients into the verandah, or into the best-lighted place. In the plans of hospitals the necessity of any such provision seems to be entirely ignored. During an important surgical operation a mirror had to be used to throw the sunlight into the dark room where the operation was performed. Wherever there is a defect of light, there must necessarily be defect of ventilation along with it. The hospitals generally are, in some points, no better than the barracks. The mode of ventilation is often liable to the same objection as in barracks ; they are not seldom deficient in several desirable conveniences. There should be connected with the hospital of every European mounted corps, and within the same enclosure, a separate hospital for native followers, capable of containing at least 30 beds. Hospital tents for sick European troops should be of large size, and uniformly double-walled, with 2½ feet space between. Tents of this construction are warmer in cold weather and cooler in hot. In Bengal the only tent available for hospital purposes was the ordinary single-walled tent issued to the troops. Privy tents, as in Bengal of late years, should uniformly be allowed for troops on the march or in the field. Lock hospitals, and a more thorough system of control in view to the prevention of venereal disease, are much called for. At present there is no proper system of control ; and any system, to be effective in its result, must be carried out by general co-operation at stations, and not left to individual effort. Venereal disease, in some form or other, is frequently, as to number, the most prominent disease in hospital. Has known it amount to about one half of the total number in hospital. Umballa is a good station ; and next to the single barrack at Meeanmeer, the dragoon barracks at Umballa were the best he saw in India. The soil is a light sandy one mixed with clay. It is liable to inundations ; and one took place in 1852 or 1853, which was attended with very serious effects upon the health of the troops. The embankment that keeps out the water of a nullah between Umballa and the hills broke down, as it has done on several occasions, overflowed the station, and the troops suffered very much in that year from cholera and fever. The health of Umballa has greatly improved of late years, since greater attention has been paid to sanitary arrangements. Kirkee, with all its present disadvantages as to barracks, &c., is by far the healthiest station he has ever served at in India. The barracks are very old and very bad, with the exception of two barrack rooms built within the last few years. The position of Kirkee is very favourable to drainage, it stands upon a ridge, and therefore very little artificial aid is required to perfect it. They are old-fashioned and very badly-constructed barracks, and some of them so little elevated that they are not eight inches from the ground on either side. The floors, except those of the two new barrack rooms, are earthen, and frequently subjected to a filthy nauseating process called "cow-dunging." That is, cow-dung, by the addition of water, is reduced to a semi-fluid state, and the whole floor is varnished over with the mixture and left to dry. The effect for the time being is to render the rooms damp and offensive. This disgusting practice ought to be discontinued in all buildings occupied by European troops. All the guard rooms at Kirkee are bad, and too confined as to accommodation, &c., with exception, perhaps, of the

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bazaar guard room recently built. Cells bad. The height of Kirkee above the mean level of the sea is 1,855 feet.

ABLUTION ACCOMMODATION. 762–3.

In some barracks ablution rooms can scarcely be said to exist, or if a place is set apart for the purpose it is very inadequate, being often dark, confined, and in every sense inconvenient, even for the ordinary washing of hands and face. Has never seen a single instance in which anything like adequate means for the purposes of ablution existed. The men wash themselves as they best can ; perhaps in the open verandah, if there is no other convenience, or perhaps in some small, confined, dark place off one end of a verandah, where water vessels, &c. are usually kept. Take Kirkee, for instance, where even in the hospital it was only within the last year, 1858–59, that a washing house was added to one wing of the hospital for the use of the patients, who previously had to wash, in all weathers, in one of the open verandahs of each wing of the hospital.

WATER SUPPLY. 764 to 768.

Water is generally brought by water carriers, by hand labour or by bullocks ; generally hand labour, when the wells are very near. There are not always baths. There is a general deficiency of proper and convenient means for promoting due personal cleanliness, health, and comfort among the troops in a climate such as that of India. No plan for maintaining thorough cleanliness, health, and comfort among European troops will be complete which, in addition to proper spacious washing houses attached to barrack rooms, will not also include a plunge bath for each wing of a regiment for occasional use under proper regulations. There would be no difficulty about water.

SANITARY SERVICE. 769 to 779.

Of late years there has been more attention paid to cleanliness in the camps and cantonments ; there is often great room for improvement. There is a great want of responsibility on the part of some particular person at stations to see that sanitary measures are promptly and effectually enforced whenever necessary, or whenever attention may be called to the subject. There are certain rules laid down applicable to camps and cantonments, in themselves very good, to be carried out by the quartermasters of regiments and station officers, under the quartermaster-general's department. But at the same time, although those regulations are tolerably well carried out at certain stations, they are not so in all, and some more decided attention to the subject is necessary to ensure sanitary measures being promptly and thoroughly enforced in practice. There should be persons fully supported by authority whose especial duty it should be to see that sanitary measures are strictly enforced throughout stations and in their vicinity. Too often representations regarding essential points meet with no apparent attention, and lead to no immediate beneficial practical result. Some more effective means than have hitherto existed ought to be established to ensure representations regarding ordinary sanitary measures and other points involving the health and welfare of the troops being instantly and effectually attended to, and to establish some salutary check to prevent unreasonable disregard of suggestions or measures in which the health and efficiency of the troops may often be materially involved. The details given in sanitary reports from corps have not hitherto received the attention required, if, indeed, they are attended to at all ; and one consequence is that glaring evils reported on by regimental medical officers, perhaps year after year, remain unabated. These reports, if properly attended to, are calculated to effect much good. The appointment of sanitary medical officers, distinct and apart from those who are appointed for the treatment of disease, would be extremely beneficial ; provided always such officers had the power to make suggestions, and that those suggestions were promptly and

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efficiently attended to and carried out; without that such officers would be of no use.

Hill Stations. 781 to 783.

If the character of hill stations as to healthiness were ascertained by careful investigation, a change to the hills would be of great benefit to the troops; provided, that while on the hills they were furnished with comfortable barracks, and that proper commissariat arrangements were kept up, and that their clothing and comforts were properly attended to. It is very desirable, so far as it could be carried out, that the troops should be permanently kept on the higher stations, and should only descend into the plains when wanted for military purposes.

Drink. 784 to 796.

The ordinary drink is arrack, and malt liquor—beer and porter. There are often other liquors kept in canteens, which men can obtain, such as brandy, gin, port wine and sherry, and perhaps some others; but they are for particular occasions, and are not commonly used. Water is a good deal drunk in India. The water supplied to the troops generally is considered to be of good quality; but there is often a good deal of saline matter in it, which may be observed after evaporation from a glass; it leaves a certain efflorescence. Of late years the ration issued to the men has been very good. The way in which water is kept in the barracks is sometimes objectionable. The water is kept either in wooden casks with a square hole cut in the top, generally open, or in a large earthen jar. The man dips a vessel into the cask or jar, and the sediment is apt to be disturbed. Drinking water should be previously filtered, and stored so that the men could draw it out by taps. Water is often filtered, but not generally, through porous earthen vessels placed in a wooden framework one over another. It is desirable to ensure the men getting thoroughly pure water; when the quantity falls low, and a man goes in the dark, he does not know what he may drink, he may take up a great deal of sediment.

Married Quarters. 798 to 800.

The hut system for married quarters is the best; perhaps one building of proportionate dimensions might be made to contain two families, with a central cross wall dividing the accommodation for each family. Families are better off in Bombay than in Bengal. There is a European matron allowed in female hospitals in Bombay—a great advantage. In Bengal no matron is allowed.

Intemperance. 802 to 803.

It would be very desirable to discourage as much as possible the use of spirits among the troops by every practicable means, and to supply them with beer at a price within their reach. The brewing of beer at hill stations in India should be encouraged. In a great measure the sale of spirits might be discouraged, but it is not advisable to abolish it entirely in canteens, because there are occasions on which men may desire spirits, and when it will do them good. The majority of soldiers would greatly prefer malt liquor to spirits, and the only reason for their not using beer almost exclusively is, their means being insufficient to procure it. The use of malt liquor is far more conducive to health than that of spirits; it would also lead to less crime and irregularity. The consequences of prolonged over-indulgence in malt liquor are more manageable and less fatal in their result than those produced by a similar abuse of spirits. From the time of the arrival of the 14th Dragoons at Meerut early in 1851, until their departure for Bombay early in 1855, the health of the regiment had been better, and the mortality less than during any previous period. At Meerut, English malt liquor was more easily procurable, and at a cheaper rate. There was also a light description of draught beer brewed at the station, and sold a little cheaper than English beer. Both were for a time very generally used. The result was, that the consumption of malt liquor increased, and that of spirits decreased. General health

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also improved, and mortality diminished. When malt liquor was obtainable at a low rate, the proportion of spirits issued daily in the canteen frequently did not amount to the rate of one dram per diem, and sometimes not to more than half a dram, for every man. A soldier is allowed by regulation to have two drams of arrack a day, without any malt liquor, or one dram and one quart of malt liquor. The issue of any liquor from the canteen, until the men have dined, is prohibited.

SANITARY SERVICE. 805–6.

When any epidemic is going on there is always a quiet system of observation established—at least he has been accustomed to see that done. But if a regimental police observation could be carried out it would be a very good plan, and to extend not only to epidemics, but to other points; for instance, as to whether men are irregular and drinking too much, and carrying it on secretly, as some men do for days together, and then they come with delirium tremens, and perhaps die.

DRAINAGE. 807 to 809.

In many stations the surface of the ground is irregular, having saucers or hollows retaining stagnant and impure water, but some change has taken place in levelling, although never to the extent required. The ground required clearing and levelling, and a more thorough general attention to sanitary arrangement throughout all the stations at which he has served. The same remark applies to deficiencies in surface drainage and sewerage.

DRESS. 809 to 815.

Any metal head-dress is altogether unsuited to a hot climate, and particularly that of India. It is most desirable with regard to the health of the troops that the brass helmet should be discontinued in the hot climate of India, under all circumstances, whether with or without a cover. Lord Clyde has lately introduced wicker helmets. Neglect in these respects leads to sun-stroke, one of the most fatal diseases of the North-west Provinces in the hot months. The leather stock is done away with in India, by order from the Horse Guards. Flannel under-waistcoats should be worn under all circumstances and in all seasons, care being taken to ensure cleanliness by frequent change ; likewise drawers, either flannel or thick elastic cotton, in the cold months, and light calico, if preferred, in the hot season. A loose, strong, woollen coat would be most beneficial as a fatigue dress for cavalry, and for use about the barracks. The loose Khakee summer clothing is a great improvement. The wicker helmet with quilted covering is likewise an improvement. The best material for a soldier's head-dress in India is a helmet made of light-coloured drab felt, of considerable thickness and firmness to resist considerable pressure, and so constructed as to favour, as far as practicable, free ventilation. The helmet should have two quilted covers for change, made of white calico, with an intervening layer of thick, fleecy flannel, with a curtain behind four or five inches in depth, or sufficient to protect the back of the head and neck from the sun.

DUTIES. 815 to 821.

With regard to drilling of troops, it would be a great point towards the efficiency and health of the troops in the North-west Provinces, and other places, if drills and all laborious duties were prohibited, as far as possible, during the hot and rainy months of the year, and were confined entirely to the cold weather, and then vigorously pursued. Very frequently the recruits arrive about the end of the cold season : there is a great temptation to drill the recruits before the cold season, and generally the effect is that the men break down. It fills the hospitals, and sometimes men go to the grave from it. If a man, say, for the first month, learns anything, he, too generally, goes into hospital with fever, or some other serious ailment, and continues there perhaps for the remainder of the hot season, and by the time he gets out of hospital, if he gets out at all, at the

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beginning of the cold season, he has entirely forgotten all that he learnt before, so that it would have been much better if he had been left alone until the proper season for drill arrived. To the opposite system pursued for several years in the 14th Dragoons, cannot but be attributed much of the comparatively good health which they enjoyed, and the small mortality amongst them, and when the time for active service in the field came these men were just as efficient as any others. It would be well, as a uniform rule, to furnish commanding officers of regiments and detachments, on arrival in the country, with explicit sanitary regulations for their information and guidance on this and other points bearing on the health of the troops. During the rest of the period, the men might have parades and quiet movements, just sufficient to keep them together, but without over-exertion and fatigue. There is another point of great importance, which is, that instead of sending young men to India undrilled, they should be sent out drilled, and in a great measure, if not entirely, formed soldiers, and instead of sending young recruits of 18—no man ought to go out under 20, or from that to 25—and then he ought to be a drilled soldier. This might lead to a little expense, but the effect would be good, and the efficiency of the army in India much increased.

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Staff Surgeon David Field Rennie, M.D.

Sanitarium, Western Australia. 828 to 868.

Quartered for six years and a half at Fremantle, in Western Australia. At Fremantle, the mean temperature of the winter months, extending from May to October, is 60°, and that of the remainder of the year about 73°. There are no great extremes. It would be difficult to imagine a more delightful temperature and climate generally than that of Western Australia. The Western Australian winter may be said to bear a close resemblance to the ordinary English summer. The Australian summer may be compared, on an average, with what represents about the hottest portion of an English summer. The atmosphere of Western Australia generally is remarkably dry. The town of Fremantle, the chief port of the colony, is situated at the level of the sea, on the southern side of the entrance to the Swan river, in latitude 32°, longitude 116° ; there are elevations, however, in its immediate rear, on the slope of which public buildings have been erected. The other coast settlements are situated also at the sea levels, with high lands in their vicinity. There are various ranges of hills scattered over the interior of the colony, some of them of considerable extent. The whole colony is healthy ; endemic disease is unknown, and epidemic influences are rare in the extreme. Small pox, scarlet fever, measles, &c., are as yet unknown in Western Australia, acute pulmonary affections are rare. The soil varies considerably in different portions of the colony, but as a general rule it may be said to be very sandy, though abundance of light loams, red and black clays, exist from one extreme of the colony to the other. The colony is not much cultivated, and its general aspect is that of a very primitive settlement, presenting vast extents of forest land, covered with mahogany and gum trees of considerable size. Two hundred miles to the north of Swan River a fine open pastoral and agricultural country exists. The prevalent winds are north-westerly and south-easterly. The westerly winds are the most prevalent ; they blow right in from the Indian Ocean, generally from May until the commencement of October. The hot winds are easterly breezes during summer. The cold season is the rainy season. It generally commences about the end of April. The heavy rains do

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not set in as a general rule before June, and they usually terminate about the end of July or commencement of August. The rain-fall is from 33 to 34 inches. Swan River is the only river of any extent. For 14 miles, namely, from Fremantle to Perth, it is a considerable body of water, at one part being about three miles broad. A few miles above Perth, the river degenerates into an insignificant stream. For colonial consumption, the chief articles raised are—wheat, barley, oats, Indian corn, hay, potatoes, and vegetables of every variety, grapes, peaches, nectarines, lemons, oranges, loquots, bananas, melons, pumpkins, apples, pears, almonds, olives, pomegranates, mulberries, raisins, figs, &c. The fruits are remarkably plentiful and very cheap. The grapes are not to be surpassed in any portion of the world. Provisions generally are plentiful, and are becoming more so every year. Cattle are plentiful. Vegetables are very plentiful, and of superior quality. The physical effects of the climate are exhilarating and invigorating.

EFFECT OF EXCESSIVE DIET IN WARM CLIMATES. 870 to 885

The convicts have suffered a good deal from sickness during the summer, attributable not to the hot weather, but to the conditions under which the men were living during the hot weather, every elementary principle of hygiene being overlooked in their management. They were much over-fed, in addition to which they were located at night in double tiers of hammocks in crowded association wards, with urine and manure tubs placed in their centre at intervals of about 25 feet from each other, and shut up with them the whole night; the cubic space of air amounted only to 280 feet per man.

The convicts who performed ordinary prison work, received daily—fresh meat 18 oz., bread 27 oz., potatoes 16 oz., soup, thickened with oatmeal or rice, one pint, tea two pints (one morning and evening), containing $\frac{1}{3}$ oz. tea and $1\frac{1}{2}$ oz. sugar, with one extra ounce of sugar in lieu of 2 oz. of sweet milk (which formed a portion of the ration, and was not procurable at that time), one drachm pepper, $\frac{1}{2}$ oz. salt, $\frac{1}{4}$ oz. tobacco, and $\frac{1}{6}$ of an ounce of tea to be infused and used as a beverage during the day, while work was going on. In addition to these articles, the convicts who had labour to perform calling for a greater amount of muscular exertion, such as sawyers and blacksmiths, and the men who attended them as labourers, received an extra issue of 8 oz. meat and 6 oz. bread, making their daily allowances respectively 26 oz. of the former and 33 oz. of the latter. The extraordinary prevalence of diseases of the digestive organs (chiefly cutaneous eruptions, ophthalmia and dysentery, for the most part occurring by the process known in medicine as metastasis, that is, a disease suddenly disappearing in one portion of the body, and immediately reappearing in another) revealed the mischievous effects which the large ration was producing amongst the prisoners generally. A considerable reduction was urged as a primary sanitary measure, but strongly opposed on the grounds chiefly that diet, in excess of what might be actually physically necessary, was essential to discipline. A medical board, after careful personal investigation, recommended that the diet should be reduced to 14 oz. meat, 22 oz. bread, 12 oz. potatoes, with a pint of soup twice weekly in place of daily, as formerly; the tea, sugar, and other items remaining the same, with the exception that the extra tea for a day beverage, and the ounce of sugar in lieu of milk, were abolished. The recommendation was carried out, and the result was an improvement far exceeding my most sanguine expectations in the general sanitary condition of the convicts. On the return of the hot season the following year, they again began to suffer from diseases originating in disordered digestion, though by no means to such an extent or severity. It was proposed to reduce the number

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of men sleeping in association to one half; to abolish double tiers of hammocks; to remove urine tubs and means of defecation from the wards; to reduce the quantity of animal food and of fermented bread; to introduce compulsory ablution of the whole person; to abolish sea bathing, unless an issue of marine soap could be made to the men; to issue bran bread or biscuit, in place of the ordinary ration bread, as a preventive of constipation; to abolish the issue of tobacco. These recommendations were opposed on disciplinary grounds; but the comptroller-general previously ordered the greater portion of them to be carried out, and the result which followed was most satisfactory, the general health of the prisoners improving in a very remarkable manner. These details afford a practical illustration of the necessity, in supervising bodies of men, for carefully distinguishing between diseases originating actually in climate, and those which originate in habits and conditions of life unsuited for particular conditions of climate; a very large proportion of those ailments which are familiar to us under the name of "diseases of tropical climates" are in reality the diseases resulting from habits and circumstances of life generally unsuited for tropical climates, the relation which food (including alcoholic stimulants) bears to temperature being seriously overlooked in the dieting of bodies of men in the public service, constituting a branch of hygienic science that has not yet received that attention which its importance merits. The use of tobacco in all hot climates for the European, and more especially the Anglo-Saxon (whose habits generally are so unsuited for the tropics and other warm latitudes), is very injurious. The per-centage of deaths in the whole colony by the last census returns was only 0·55 per cent., or 5½ in the 1,000. The numbers of the native population are stated to be rapidly decreasing. The cause to which is inclined to attribute it is, simply, that the aborigines have now the means of gaining a livelihood much more easily than they had before the arrival of European settlers. Formerly the hunting of the kangaroo was a difficult and elaborate process, a great deal of physical exertion being entailed on them before they could procure animal food in any quantity; but now they have adopted the European method of running the kangaroo down with dogs, they are not now called on to exert themselves as nature intended, and to the complete change which has taken place in their original habits is to be attributed the physical deterioration they are now undergoing. They have formed habits of repletion in exchange for habits of previous abstemiousness. They are very prone to copy bad habits from the Europeans, especially tobacco smoking and the use of spirits. The passage could be made at all seasons from Calcutta to Fremantle with an ordinary fast steamer, say a ten-knot boat, at an average of 20 to 24 days.

EXTRACTS FROM DR. RENNIE'S REMARKS ON DIET, ALCOHOL, &c., IN WARM CLIMATES.

The results of all modern research tend to prove that diet should be in proportion to temperature. Our instincts in most cases lead us readily to recognize the necessity for the adaptation of clothing to temperature; but we are not equally ready to believe that the same rule applies to food; nevertheless, such is the fact. The quantity of food required is regulated by the number of our respirations, by the temperature of the air we are at the time breathing, and by the amount of heat given off to the surrounding medium; our clothing to a certain extent acts as an equivalent for food, from its lessening the oxidation of the system,—in the words of Liebig:—"No isolated fact apparently "opposed to this statement can affect the truth of this natural law, "without temporary or permanent injury to health; the Neapolitan "cannot take more carbon and hydrogen in the form of food than "he expires as carbonic acid and water; and the Esquimaux cannot

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" expire more carbon and hydrogen than he takes into the system as " food, unless in a state of disease or starvation ;" and thus it is that we find the Laplander feeding on blubber, and such other highly carbonized food, while the Italian lives chiefly on maccaroni, which nourishes without overheating him. According to Liebig, the food prepared by nature for the inhabitants of southern climes does not contain more than 12 per cent. of carbon, while the blubber and train oil, which constitute the food of the inhabitants of polar regions, contain 60 to 80 per cent. of that element. The true use of food is to counteract the oxidising power of the atmosphere—the more oxygen which enters the system the more food will be required—the less oxygen, the less food consequently will be necessary ; and as equal volumes of air in different latitudes contain very unequal amounts of oxygen, the quantity becoming less as temperature increases, it is not difficult to perceive why different dietaries are required in the tropics and in the arctic regions. Certain scales of diet have been determined for bodies of men under different circumstances of life—that calculated by the eminent physiologist, Dr. Carpenter, as being sufficient for a labouring man exposed to the ordinary vicissitudes of an English climate, allows from 30 to 35 ounces of animal and vegetable food—though, adds Dr. Carpenter, "A healthy condition may be kept up on scarcely " more than half this allowance, if the muscular powers are but little " exerted, and the surrounding temperature be high." The diet of the English soldier serving at home may be represented as having hitherto consisted chiefly of 12 oz. of meat, 20 oz. of bread, and 16 oz. of vegetables, which makes 48 oz. of animal and vegetable food, and allowing a loss of 8 oz. for bone, cooking, and waste, brings it down pretty close on the physiological estimate of Dr. Carpenter. The ration of the soldier serving in England is as follows :—

1¼	lbs.	bread
¾	lb.	meat
⅛	oz.	coffee
⅙	oz.	tea
1⅔	oz.	sugar
1	oz.	salt
1/24	oz.	pepper

For this ration the soldier pays a stoppage of 6*d.* per diem from his daily pay of 1*s.* 1*d.*

In addition to the articles here detailed, the soldier buys at his own expense about one pound of vegetables, and expends also, as a general rule, one penny on beer, and a trifle on milk, which, with washing and stoppages for regimental necessaries, leaves him not more than three halfpence or twopence per diem for tobacco and pocket money. This ration is deemed ample for the climate of England, where the average temperature of one half of the year is 37°, and the other half 63°, the mean consequently being 50°. It is necessary, however, now to follow the soldier to the plains of tropical Hindoostan, where he probably will be found panting under a heat of 87° or 90° in the shade, with fever and dysentery raging around ; and on looking to his diet, the following will be found to be the ration established by law and served out by routine to all British soldiers serving in India :—

1	lb.	bread
1	lb.	meat
1	lb.	vegetables
¼	lb.	rice
2½	oz.	sugar
1⅜	oz.	coffee or
⅝	oz.	tea
1	oz.	salt.
3	lbs.	firewood

This ration is not only issued free to the European soldier in India, but he receives in addition "a spirit ration," amounting to about one gill and a half of rum daily.

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A comparison of these two diet scales, and of the temperature in which they are respectively consumed, demonstrates one of two things, namely, either that the soldier in India is very much over-fed, or else that the researches of modern chemistry as applied to physiology are mere visionary speculations, and nature herself in error, when she indicates special articles of food for special regions of the earth. Colonel Sykes in his "Vital Statistics of the Indian Army," says—"I "never followed a farinaceous or vegetable regimen myself in India. "nor do I recommend it to others; but I ate moderately and drank "little, and I have a strong conviction that much of European disease in "India is traceable to over stimulus, and that the mortality amongst the "European troops will not be lessened until the European soldier is "improved in his habits, until he is made to understand that tem- "perance is for the benefit of his body, libraries for the benefit of his "mind, and savings banks for the benefit of his purse. The climate "of India is less to blame than individuals, for in case foreigners find "the people in a country healthy, they should to a certain extent "conform to the habits of the natives to be healthy also." Dr. Mouat, of the Indian army, Inspector-General of Jails in Bengal, in the "British Soldier in India," remarks, in reference to the question of food, "Most Europeans in the tropics, in easy circumstances, consume "more animal food and stimulant beverages than is good for them. "The soldier in particular, except in the field, eats too much meat, "drinks more of strong liquor than his system can dispose of with "impunity, and takes too little exercise to ward off the effects of his "stimulant dietary. The result is that he attains the condition of a "Strasburg goose, of which disease and death are the penalty." "Mr. "Macnamara in India, and Mr. Gaunt in England, have shown that "the results of the over-feeding of men and cattle are nearly identical. "The excess of carbon is not consumed, and being deposited in the "form of fat in the liver, kidneys, heart, and muscular tissues proves "rapidly destructive." The effect of alcohol on constitutions suffering from excess of carbon and hydrogen, derived from a superabundance of food and a deficiency of oxygen, will be simply that of adding so much fuel to the flame. The tendency to the accumulation of carbon and hydrogen already existing necessarily becomes materially increased; the results being the development of disease, varying in degree from external obesity to the graver forms of fatty degeneration of internal organs. With the soldier in India the habitual use of alcohol must be viewed in the light of a slow poisoning process—and as such, there can be little doubt that indulgence in spirits, whether habitual or occasional (unless when ordered medicinally), should be discouraged as much as possible amongst European troops while serving in tropical countries. The bulk of the soldier's diet in India should be represented by bread, vegetables, and tea, with a very moderate allowance of fresh meat. In Australia, experience, unbiassed by any temperance theories, has compelled the bushmen and the agricultural settlers generally to adopt tea as the most thirst-quenching beverage, and at the same time the only one suited for those who have to undergo exposure to the powerful summer sun of that continent, in the course of their daily outdoor avocations;—and the substitution of a beverage ration of tea for the one of spirits, now issued, would be a most important hygienic experiment, fraught with much benefit to the army generally in India, but more especially to the young soldiers on their first arrival in the country, who would thus be saved from the pernicious consequences of the slow alcoholic poisoning to which they are exposed from the first day they land. In reference to this question Dr. Mouat says:—"The

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" practice of issuing rations of rum to young recruits should at once " cease ; many a fine lad has been ruined by it." There is no more common cause of the sun stroke, which is so fatal to the British soldier in India, than the use of alcohol, from the tendency which it has to cause visceral congestions.

Col. R. H. Gall, C.B.

Colonel RICHARD HERBERT GALL, C.B., 14th Light Dragoons.

SANITARY CONDITION OF STATIONS AND BAZAARS. 897 to 942.

Served in India for about 20 years, at Lahore, at Mhow, and Belgaum, at Kirkee and Meerut principally. Kirkee is one of the most healthy stations in India. Meerut is also considered a very healthy station, comparatively. It would be advantageous to extend the station ; there might be two regiments by having good barracks at Kirkee ; they are very bad now. The water runs dry in some of the wells. In hot weather the barracks are very close ; they have no ventilation and they are not of any size ; the new ones are decent barracks, but nothing very particular. They have no protection from the monsoon, the wind and the rain beat in in the rainy season, during the hot season they are decidedly very hot. The chief requirements of a good barrack in India are loftiness and good ventilation, but a particular kind of ventilation—not that which depends upon the doors and windows—which admits of a great deal of thorough draught, and leaves the men exposed to it. There should be sufficient space between door and door, and window and window to allow the men to be able to sleep without being exposed to a draught. Men should be able to set a table between two beds. A double roof is a decided advantage in a barrack, and a very broad verandah. Kirkee is well drained, as there is good natural drainage. Meerut is elaborately drained, but the drainage is not good, as the ground is against the engineer. The drains are open ; the drainage is so sluggish that it is very often swept down by the hands of sweepers, and nuisances exist connected with it. At Meerut wash-houses were introduced in 1853. There was built for each two barracks a wash-house, but it was not sufficient. The men had to come out into the sun to go to the wash-house ; there not being a covered way is a great objection. A good swimming bath is a great addition to the comforts of the men. It should be very large and deep. The water is at no great depth at Meerut. You might sink wells in the sand at Meerut with the greatest ease anywhere. At Kirkee the digging of wells is difficult, but the river is there, and it has been dammed, and the troops have every advantage of that kind. They have bathing parades, and the men are constantly marched down to the river-side to bathe. In every troop or company a man is engaged as washerman, and he engages his own servants, and he washes for the men. The captain contracts on the part of his men for the washing generally ; the arrangement is a very good one. For maintaining cleanliness the orderly officer in each regiment goes through the barracks every day, and he has to report to his commanding officer that the barracks are clean ; that they appear so generally. The barrack floors at Kirkee are of mud ; they should be of stone. The custom of washing mud floors with cow-dung is objectionable. If there were nuisances lying about or the drains offensive they would be reported to the orderly officer, and by him to his commanding officer. There are no means of removing the cause of complaint immediately if a large expenditure were involved in the removal. The command ing officer cannot involve himself in any expense, but he would report it to the brigadier commanding the station ; but the brigadier cannot go beyond a certain amount, and that a small one. If it was a nuisance

that required to be immediately removed, and not involving great expenditure, there would be no difficulty, for the commanding officer would report it emergent, and the brigadier would issue an order immediately to the executive engineer of the station, "on emergency." If it was expensive the executive engineer would have to report it to his superior, and it might be referred further. There are "station orders" as to maintaining cleanliness; every officer has a copy of them sent to him, or is bound to make himself acquainted with them. The bazaars are, at a large station, under the superintendence of an official, specially appointed, called the bazaar master; he is invested with magisterial power which gives him a great extension of authority. Clandestinely a great deal of liquor is sold in the bazaars; but the bazaar master's duty is to prevent its being sold to soldiers; he has extensive power to punish very severely those who sell liquor without authority. Those powers are exercised. The camp followers are quartered generally at a little distance from the lines, outside; they are under the supervision of the commanding officer. The quartermaster has general supervision of the lines as to cleanliness, and it is his duty to cart away all rubbish or any nuisance; his care extends to the camp followers. In order to prevent the venereal disease being spread among the troops, the commanding officer, and also the person who has charge of the bazaar of the regiment, (in some places it is the interpreter of the regiment,) would see that no persons of improper character were in the bazaar without permission; any such person would be turned out. There is no medical supervision. If a woman were known to be diseased, the commanding officer would be applied to to turn her out of the bazaar. The bazaars are kept comparatively in very good order. Great attention is paid to cleanliness, and they present a favourable contrast with any native town; but where the natives are concerned there is great difficulty in overcoming their habits.

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The ration is ample. It embraces meat, bread, and a good supply of vegetables, sugar, tea, rice, salt, and firewood. The ration is issued at the rate of three annas and four pies, about 5*d.* a day in English money. It is stopped from the men. The men have three meals a day. With regard to the ration of meat, they generally make an arrangement with the cook, if they do not like the meat. The captains of troops have the adjustment of this matter. They engage a cook, just as they engage a washerman, to cook for their troops, and the men make an agreement with the cook to supply them with some trifling articles besides attending to the cooking, and if the cook will supply some trifling articles in addition, the men pay him a little more; but that is all done under the superintendence of the officer. For cooking alone the charge is about ten annas per month; for one anna per diem a cook will supply meat for breakfast, milk, and sometimes butter, &c., in addition to cooking. The "large bone" is separated from the meat before it is weighed for issue by the commissariat.

RATION. 944 to 947.

The usual beverage is the spirits they get from the commissariat, and porter. They are made to drink the spirit with water; the officer is responsible for that. Spirits are sold at the canteen, where a man may purchase at the rate of one anna a dram, and he drinks it at the canteen; he is not allowed to drink it elsewhere. It would be difficult to discontinue it, because there is a very deleterious kind of spirit procured all over India, so cheap that a man may get drunk upon it for a halfpenny. There is intemperance among the men at times when an issue of money is made to them. Native troops are proverbially sober, generally speaking very sober men, but they chew opium and

INTEMPERANCE. 948 to 960.

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smoke intoxicating drugs. The issue of one dram and one quart of porter or two quarts of porter is sufficient for any man. Porter is about 4½*d.* a quart, and it is sold cheap to the men. The porter is cheapened expressly, but a man can only get one quart of porter for the price of three drams; they prefer porter generally. The habits of the soldier in India have improved. Their health must improve where there is greater sobriety.

MEANS OF INSTRUCTION AND RECREATION. 962 to 981.

The usual means of recreation provided are cricket, bowls, fives, or hand ball, dancing, theatricals. They resort to the library and to the schools, which are very good. They have gardens at some of the stations, and very useful things they are. The men take to them and like them very much. Vegetable gardens are not so useful as flower gardens. Flowers greatly amuse the men; doubts whether they could raise vegetables so cheap as to make it worth their while. There are workshops, only regimental ones; they might be larger. Men do work as tinmen, curriers, carpenters, and turners, occasionally. You must supply tools and erect a building for them, and take any kind of risk off the soldier at first. He does not like to speculate in the matter. They would undertake the trades of saddlers, tailors, printing, and shoemaking; but there is this danger, that the men who plied these trades would make a certain sum of money, and a soldier with a certain sum of money in his hands is apt to spend it ill. The remedy would be to forbid a man who spent his earnings on drink to work, and grant every reasonable indulgence to the sober and industrious one. Generally there are no covered places, or shaded with trees, provided for the men. During a portion of the year it is very hot, and by order the men are confined to the barracks. The order, strictly carried out, would be that a man is to remain in his barrack, and if he was seen walking out in the sun in the barrack yard he would be liable to confinement.

DRESS. 982 to 986.

The cloth tunic is admirably adapted for ten months in the year, especially for wet weather. In hot months troops now wear a kind of canvas frock, which is very good indeed; generally the tunic is a very useful dress. It should be open under the armpit, and it should be loose in the sleeves; a tight sleeve is objectionable. Flannel should always be worn next the skin. For the head there can be nothing better than a felt helmet with a peak before and behind, and a white turban bound round it, so as to protect the temples and back of the head; all sportsmen wear this. In the field the hussar boot is preferable to trousers and Wellington boots. In weather at the same time hot and wet a light waterproof cloak with a hood would be serviceable.

HILL STATIONS. 988 to 990.

If the troops in India could be quartered along the high ridges and places of altitude, it would of course be advantageous to them; railways will facilitate transport. At present each regiment, to a certain extent, takes its turn on the hill stations. It would be advantageous to have large permanent hill stations; this is a subject the importance of which cannot be overrated; a considerable body of European troops located on the lower range of the north-western Himaleh would not only hold India securely, but it would be prepared to meet at any moment invasion from the north-west, and defend the line of the Upper Indus; were permanent stations established here they would partake of the nature of military colonies; marriage should be encouraged, and inducements held out to settle; children born in those regions of European parents grow up healthy and strong, and I believe that Europeans generally would enjoy as good health as in Europe.

Col. R. H. Gall, C.B.

MARRIED SOLDIERS. 1001 to 1012.

In India a man cannot marry without the consent of his commanding officer; if he does marry, his wife is not entitled to a certain allowance which is given, of five rupees a month. About 12 per cent. are allowed to embark with their husbands for India. The men marry Europeans and natives; they are allowed to marry a native. A native woman receives half the sum that an European would. At Kirkee the married men all lived separately in small bungalows, which are at some distance from the barracks. At present there is no sufficient provision for the women in most parts of India. No good would result from increasing the facilities for the marriage of soldiers. The general result of a man marrying a native woman would be that he would remain in the country, and volunteer into another regiment.

WORKSHOPS, &c. 1013 to 1020.

The soldier in India should be provided with covered ball courts and some large buildings in which men might practise single stick, fencing, and gymnastic exercises. The object of workshops is not only to amuse the men, but to furnish skilful artificers who, with little assistance, would supply the wants of a regiment on a distant expedition. The soldier has no day room; he has the library, or canteen, but no room for general amusement or resort, where men would feel themselves perfectly at ease.

Capt. J. E. T. Nicolls.

Captain JAMES EDMUND TANNATT NICOLLS, Madras Engineers.

SANITARY CONDITION OF STATIONS. 1021 to 1103.

Has served nearly 20 years at Ferozepore, Loodiana, Cawnpore, Allahabad, Agra, Mynpooree, Futtypore, Dugshai, Kussowlie, Subathoo, and Dinapore. The stations in the plains are all of one description, the country being perfectly flat, with very slight undulations, just sufficient to carry the water into the nullahs which run near. The hill stations are one and all situated on a ridge or spur of a hill. In the rains the station of Dinapore is completely surrounded with water; Futtypore has a few marshes about it; the remaining stations are free from any considerable collection of water. Irrigation is universal in the neighbourhood of the plain stations to a greater or lesser extent, but it is merely sufficient to water the crops and not to produce malaria. The water dries up quickly; for the most part it is drawn from wells. It is not at all like an English water meadow. There is every facility for surface drainage and none for underground drainage or sewerage; there are no sewers, there is not fall enough. As the rule it is surface drainage by shallow surface drains; there are no cesspools. The ordure is carried off by hand and in carts, and buried. In the towns the pigs generally perform the duty of scavengers. The refuse of stables and cowhouses is constantly burned. The urine is all thrown away; there are no such things as urinals, except for the troops. When a new station is required, a committee consisting of two military officers, two medical officers, and the civil officer of the district, is assembled. The engineer of the district attends the committee, and furnishes a report if called for, and gives his advice. If the committee is not unanimous, every dissentient member records his opinion, with his reasons in full. The report goes to the Commander-in-Chief through the usual channel, and is decided upon by the Government in communication with the military authorities. This procedure has only been in operation for two or three years, and in point of fact, it applies only to the new stations, the bulk of the existing stations have not been selected by any such careful process. None of the stations have, within a reasonable distance, hills or table land which could be occupied as military stations, except Umballa.

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As you go up the Ganges, there are no hills within any moderate distance of the existing stations. A station is generally marked out in the form of a rectangle, the longer side facing the prevailing wind. On this the parade grounds are marked out. Next come the barracks, generally in two rows in echelon, so as to allow each barrack to get the full benefit of the wind. In the rear of the barracks are the out-offices; in rear of those the canteens, schools, racket court, and so on. On the flank is the hospital, and in rear of the buildings for the men are the subalterns' bungalows; in rear of those the captains'; and in rear of those the field officers' and mess. The bazaar is sometimes in rear of those, and at other times on the flank. The ground round all the barracks and public buildings is perfectly unenclosed, with the exception of the hospital, which generally has a low or sunken wall. The officers' bungalows are always surrounded with walls, generally low. In the new stations there is great regularity, but the older stations are very irregular. There is no particular examination made, as to the nature of the subsoil, the quality of the water, and the means of drainage. The water varies in distance below the surface from about 20 feet to 70. All the water for troops is taken from wells. With regard to the hill stations, the building space is so restricted that there is necessarily not much room for selection. There is no drainage; what drainage there is is merely to carry off surface water. The privy hitherto has been a detached building with masonry seats, with openings through the rear wall to admit of cleansing. The most recent arrangement is to have a wooden seat with metal vessels underneath, removed through openings in the rear wall, and their contents are carted away. Has never seen cesspits but once, and that was at Dinapore. They appeared to have affected the quality of the water in the wells nearest to them, so much so that the wells had to be shut up and disused. The regulation is to have plunge baths in the stations for both men and women, and also ablution rooms in separate buildings. Urinals are generally attached to the ablution rooms. All the barracks and hospital buildings are of one story. The buildings are generally raised about a foot and a half or two feet. There are no means to allow air to pass underneath the floors. A double roof undoubtedly makes a building much cooler. No improvement can be made in the water supply of stations in the plains; but there is great want of an efficient arrangement for hill stations, where the water has to be carried by a long winding path on mules. The water is always filtered.

HILL STATIONS. 1113 to 1147.

One of the greatest disadvantages in the hill stations is the force of the monsoon to which they are exposed; the clouds are continually hanging about them; they disperse and re-form again very quickly; and at one moment you may be in sunshine, and feeling inconveniently warm, and shortly afterwards you may be in a cloud, experiencing a considerable chill. The present hill stations are not the best that might be selected in a sanitary point of view. A better climate could undoubtedly be found 60 or 70 miles further in the interior. It is the great distance, and the expense of buildings, roads, and transport, that has kept the hill stations so much on the outer ranges; on the inner ranges the troops would be far removed from the scene of action, and the expense of conveying provisions and necessaries of every kind would be enormously increased. Men in the hill stations in the Himalayas become excessively wearied from inaction, and they dislike those stations for that reason. They generally prefer the stations on the plains, greatly for the reason that liquor is more accessible, and debauchery and that sort of thing more common. Vegetables could

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be cultivated to any extent required for troops, and the cultivation in the hills throughout being carried out in terraces, there is no absolute necessity for having flat ground; any necessary amount of the best English fruit and vegetables could be grown. Hill potatoes are excellent. Cattle would have to be imported from the plains.

Dr. J. M'Lennan, F.R.C.P.

Dr. JOHN M'LENNAN, F.R.C.P., Physician-General, H.P., Bombay Army.

SANITARY CONDITION OF BOMBAY. 1154 to 1185.

Has served 31 years in India, with Queen's, local British, and native troops in the Bombay presidency, and principally at the presidency town. Bombay is an island consisting of two ridges of volcanic rocks of slight elevation, containing between them a level plain of sand and shells overlying argillaceous shale, of about two miles in width. On this plain, and on ground sloping slightly to the eastward, is situated the native town and the habitations of $\frac{99}{100}$ths of the population. The houses of many of the European and wealthier native inhabitants are at Colaba, a long, narrow, rocky strip raised a few feet only above high-water mark. Here are barracks and an hospital, &c., for one European regiment. In the fort there are the town barracks; they are close to the bazaar and main street, and with very imperfect separation from both. Fort George, an outwork of the Bombay Fort, contains barracks and an hospital, &c., for a regiment. The soil opposes no obstacle to drainage, although the very slight fall does, and thereon depend some of the most important sanitary defects of Bombay. The average temperature is about 80°, average daily range of thermometer 11°, average yearly fall of rain 70 to 80 inches, occurring generally in from 80 to 100 days in the months of June to September. Sea breezes only prevail in these months. Bombay is unhealthy both for Europeans and native troops, and for the native community. The ditch around Fort George, the esplanade face of the Fort generally, the beaches not far from Fort George, from the town barracks, and lines of the native troops, are all sources of nuisance affecting health. The beach nuisance, in a slighter degree, affects one side of Colaba. The bad drainage of the greater portion of the densely inhabited part of the native town of Bombay, the improper disposal of the dead, the filling up of cavities, and raising the level of parts of the island by foul dung-heaps, and the use of cesspools, must all be fertile sources of malaria, at least as affecting the civil population. Moreover, there are extensive salt-marshes on the neighbouring island of Salsette, which have a prejudicial effect on the health of those divisions of Bombay island adjacent to them. The subsoil of Bombay is not so well drained as it ought to be. When much rain falls, portions of the esplanade of Bombay, of the flats, and even of Colaba are flooded. The latrines of the barracks of Colaba and Fort George project into the sea, but their deposits are not sufficiently removed. The natives resort daily, by thousands, to the beaches and to open places, and scarcely any part of the island is quite free from disgusting smells from this cause, while the sea face of the fort, and the beach in Back bay, are really enormous and most abominable necessaries. The drainage from private dwellings passes into what was termed the main drain, which, from its slight fall, may be described rather as an enormous open cesspool, which constituted a monster nuisance. On the open beach close to the outlet of the sluices of the main drain, the night-soil from some public necessaries and from the Jamsetjee Jeejeebhoy Hospital were deposited, and rendered the vicinity most disgusting.

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The water supply is now abundant and good; it is brought into the town from Vehar in Salsette, but is not laid on into the houses yet.

BARRACK CONSTRUCTION. 1169 to 1197.

Throughout the presidency permanent barracks are generally built of brick, with tile roofs. Temporary barracks are built of wood cadgans and matting, with thatched or cadgan roofs. On Colaba the barracks are of plastered bricks, with tile roofs and stone floors. Floors are generally raised from 1 to 4 feet; but they should be raised on arches so as to permit the space beneath to be used as a place of assembly, or for amusement and work. Has known floors in the Colaba barracks and hospital to be damp. The windows are like lofty venetianed and glazed doors down to the floor, and there are openings above. 1,200 cubic feet are the regulated amount per man. The verandahs were from 7 to 12 feet wide. The verandah itself has been used for sleeping accommodation for the troops; to use the verandah in that way habitually is bad. Generally there is not enough of shade in the stations to enable the men to take exercise in the heat of the day. The men generally pass their time during the heat of the day only in the barrack rooms, and in the canteen, or on the parade ground, and fives court at play. There are ventilators frequently all along the roof. The air of barrack rooms at night, in cool weather, is at times close. Soldiers will shut themselves up.

As a whole the barrack accommodation in Bombay is very deficient; but much is done when it can be done. Generally speaking the guard-rooms are in a good condition. Military prisons are tolerably good, but dark, without free openings, and in some places they are insufficiently protected by verandahs. Much remained to be done to make the soldier comfortable as regards means of personal cleanliness in the way of ablution rooms and bath rooms. The means of ablution for patients in the hospitals are always better than in the barracks. The barrack cook-rooms are neither commodious nor convenient, and might be much improved; they are too small; bad; there are no chimneys; there is simply an open platform with fire-places along the entire length, they were very primitive.

RATIONS. 1199 to 1206.

The rations given to the men are sufficient; if the regimental authorities get bad quality it is their own fault. It would be most advantageous to abolish the spirit ration, and the sale of spirit in the bazaars. It is possible altogether to do away with spirits, substituting for it beer or porter; but beer or porter ought to be taken with considerable moderation, if health is to be retained in India. A liberal issue of beer or porter would produce a different class of disease. Great beer drinkers and great porter drinkers do suffer.

MEANS OF INSTRUCTION AND RECREATION. 1207, 1208.

If the soldier were amused and entertained he would probably take to weaker drinks, supposing that the canteen could be supplied with ice, soda-water, and so on. At all barracks there are fives courts and barrack libraries, and the men play at long bowls and cricket. No other means of recreation at Bombay. At some stations there are soldiers' gardens.

DRESS. 1212.

As regards dress, if woollen shirts were made the regulation, then cotton ones might be discarded from the soldier's kit. It would be better to have flannel always next the skin.

CAUSES OF EPIDEMIC DISEASES. 1221 to 1225.

As regards the causes of epidemic diseases, cholera is known to have a certain connexion with damp and moisture—with imperfect drainage, with the use of impure water, and of improper articles of food, with close badly ventilated sleeping places, and generally with what may be briefly termed a bad sanitary state. In Bombay those natives living in the lowest, worst ventilated, and dampest parts of the island, particularly in such places on the shore, suffer most. Cholera

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and bad fever at one time frequently prevailed in the European crews of vessels undergoing repairs in the dockyard, a close, badly ventilated situation, not far from the opening of a drain running into the harbour. The marines of Her Majesty's ship Endymion in 1841 suffered very severely from fever, distinctly attributable to night duty there. An epidemic diarrhœa occurred in a native regiment at Hyderabad, in Scinde, from using the stagnant impure water of a water-course. Panwell, the first station on the road to Poona, in a low situation on the banks of the river, and Campolee, a village situated close under the Ghauts, have long been avoided as halting places for troops, in consequence of the frequency of attacks of cholera, fever, and bowel complaints among parties halting there. Has heard of instances in which, from the men of particular barracks having suffered from cholera in excess of those in others, on strict investigation, impurities at a distance from but nearer to these barracks than the others, have been supposed to be the cause, and were accordingly removed. Intemperance, fatigue, exposure, and over-much night duty powerfully predispose to disease. Exposure, when suffering from the effects of intemperance at night, has in many instances seemed to bring on cholera; temporary deficient clothing might in these instances have added to the evil. Heat, cold, and moisture seem to exercise powerful influences. In Bombay, among Europeans, cholera is most prevalent in the hot sultry month of May, before the monsoon, and during the monsoon months. Among natives it is more prevalent in the cold months. Diarrhœa and dysentery are most prevalent generally during the hottest and wettest months; but in Bombay during the cold weather, and in the four months of the monsoon. The deaths from dysentery, in proportion to the numbers attacked, are more in the cold months than any other. Fevers in Bombay are most prevalent during the monsoon months and in November. Dysentery often follows fever, and is then most fatal. When epidemic disease appears at a station the troops are moved from their quarters into tents, and, if cholera be prevalent among the population, isolated as much as possible, particularly during marches. Barracks and native lines thus emptied are thoroughly cleansed and whitewashed. The precincts, streets, and places of assembly are purified, and the drainage looked to. Frequent medical inspections are made, and the duties and fatigues of the men lightened; the canteen is more carefully supervised. Qualified assistants are posted in the native lines with medicines. When regiments are attacked on the line of march with cholera, besides such measures, the corps is removed to some healthy spot, and tents, baggage carts, and baggage, particularly of the numerous camp followers, is purified. Corps are not allowed to enter camps or cantonments till the disease has entirely disappeared. Climate has much to do with the prevalence of liver disease. In adults more good in the way of prevention of liver disease would arise from temperance, or perhaps total abstinence from liquor, and the avoidance of rich, stimulant, or full diet, than from any other change. Rheumatism is most prevalent during the cold months, and during the prevalence of easterly winds, or when there has been exposure to great and sudden variations of temperature; also in feverish districts. It is a not very infrequent consequence of intermittent fever. The wearing of flannel next the skin holds out the prospect of greatest effect in diminishing its frequency. Although lime juice and fresh meat are used, exposure to wet and cold, bad sleeping places, and long voyages in badly found ships, are evidently causes of scurvy, since the disease is never seen in vessels in which these circumstances

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have not obtained. On the first occupation of Aden and Scinde, scurvy prvealed at times. It was checked by the usual means and by improvement in the water supply, much of the water there being saline or brackish. A slight scorbutic taint among natives is by no means rare, attributable to low fare, unhealthy abodes, and imperfect protection from the weather.

INTEMPERANCE. 1226, 1229.

The largest amount of injurious effect on the health of the soldier is exercised by climatic influences, intemperance, and sexual disease.

Intemperate habits act in making persons more liable to ordinary diseases, and they very much increase the difficulty of treatment when disease occurs. The amount of sickness from intemperance in the European general hospital in Bombay is something appalling. With the sole exception of fever, the number of admissions was larger from intemperance than from any other disease ; and as to deaths, alcohol there destroyed more than either fever, hepatitis or diarrhœa, and nearly as many as cholera. Of 1,146 cases of delirium tremens and ebrietas, 352 were soldiers, but a half of those were pensioners. 170 were sailors, 291 were paupers, 118 were women, of whom the great majority had led a barrack life; 66 were warrant officers.

HILL STATIONS. 1235.

As regards hill stations, the comparative coolness and purity of the air on the mountain ranges would make them preferable to the heated plains, though some diseases might prevail to a greater extent on the heights than on the plains. By ascending you escape much fever, and perhaps cerebral affections, but you may occasionally have more pulmonary attacks and bowel complaints. Not much benefit would arise from going above 1,800 to 2,300 feet, the heights of the principal stations now long occupied. In them a diminished prevalence of, and diminished mortality from, fevers, dysentery, diarrhœa, and epidemic cholera, is undoubted.

HOSPITALS. 1282, 1284.

Hospitals are built of brick, wood, and tiles; they vary much in their construction and arrangements. That of Fort George, and the European general hospital, are two-storied buildings, the upper stories only of which are used for the sick. The upper stories of both are raised above the ground from 10 or 12 to 16 feet; the wards are of good height, and have wooden floors, with verandahs on their fronts and rear. The amount of space per man in hospitals is 1,800 cubic feet. On the subject of medical attendance, most strongly recommends that, in point of pay and allowances of all kinds, the medical warrant officers should be put on a perfectly equal footing with the warrant officers of the ordnance and commissariat departments. For instance, while the commissariat conductor on the line of march has an allowance for a pony granted to him to enable him to be up in time to measure and distribute the ration of liquor, the medical warrant officer has no such aid to enable him to keep up with the sick and wounded, in order to be able to dispense their medicines or adjust their dressings. With regard to the ward attendants, dooly-bearers, and watermen, recommends that they should form a body to be enlisted for their services, and having claims to small pensions on becoming unfit for duty. By such means a better class of servants would be had than at present.

SERVICE IN INDIA. 1293 to 1303.

As regards acclimatizing, the man who had been one year out would be better able to endure fatigue and exposure than the man who had been ten years out. It is bad to send out boys as recruits. A young man of the age of 21 or 22 is better than one of 16 or 18. Furloughs are usually granted for fevers and their consequences, dysentery, diarrhœa, and dyspepsia, or other affections of the alimentary canal, cerebral affections, hepatic affections, affections of the lungs and air pas-

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sages, constitution injured by venereal and other excesses, anæmia and other cachectic states. There are the old and new regulations, and in the former furlough is given from three to five years; in the latter it is from 15 months to three years. The present duration of furlough might be advantageously extended to two years, with right of retention of appointment; but paying the first six months of the furlough so highly tends to drive officers back too soon, that is, before their health is thoroughly re-established. If the same amount were equally divided over the whole period deemed necessary, the objection would be removed. 15 months is in many instances far too short. For the private perhaps 40 years, for the warrant officer 50, and for the commissioned officer 60 years of age might be considered periods beyond which, except under certain circumstances, they should not be required to serve in India. 30 years of Indian service should entitle the military officer, and 25 years should entitle the medical officer, to the maximum pension.

Sanitary and Medical Service. 1307 to 1312.

The current medical sanitary duties of medical officers in barracks, on the march, and in the field embrace all matters that strictly lie in their own department, both for the cure and prevention of disease, together with the duty of urging the adoption of all measures conducive to such ends on others with whom may rest their performance, the commanding officers. With regard to medical officers not being made presidents of committees, that is an indignity put upon them which is most impolitic, and not at all necessary. Has been on committees as president, appointed by government, and in a service of 31 years in India has never seen an opportunity for the exercise of military command, and scarcely knows how it could arise. The complaint is not that a medical officer is not always president, but that he is expressly excluded by regulation, and he may have to serve under one who is much his junior.

Capt. W. S. Moorsom, C.E.

Captain William Scarth Moorsom, C.E., late 52nd regiment, and Deputy Quartermaster-General.

Cooling Air in Barrack Rooms. 1314 to 1348.

Proposes a plan for moving and cooling the air in barrack rooms and sick wards by means of punkahs, arranged as fans across the room, and made to revolve by animal force. The punkahs to be kept moist by water similarly raised. The plan differs from the ordinary punkah in this respect, that the punkah merely moves backwards and forwards, while with the rotating fans proposed there would be a very much more speedy motion. Between the primary motion, and the ultimate motion of the fans the multiplying wheel is employed, which converts the slow motion of the bullock into the fast motion of the fans. The revolutions of each fan would give 288 puffs, as it were, of the atmosphere per minute; the fans to be fixed on horizontal shafts, passing across the whole breadth of the room, from wall to wall. The 288 puffs per minute of each fan are counteracted by the contrary motion of any two fans, so that a puff of air brought in one direction is counteracted by a contrary puff of air brought by the adjoining fan, so that the resolution of these forces will create a current, not direct upon any part of the room, but an equable current throughout the room. The cost of constructing this machinery in England would be a total of 68*l.* for 100 men. Should say that the punkahs and frames are not included, but they would be best made in India.

Dr. C. Smith.

SANITARY CONDITION OF STATIONS. 1349 to 1404.

Dr. COLVIN SMITH, Madras Army.

Has served between six and seven years in India, principally with local European troops and with Native troops, likewise with detachments of Queen's troops, in the Madras presidency, and during the late mutiny in Bengal; in Burmah also during the last war. Has been posted at St. Thomas's Mount, Madras, in Rangoon, in Prome, at Secunderabad, Kurnool, and Jubblepore. St. Thomas's Mount would be a healthy station if it were not for the bad barracks there. Rangoon was very unhealthy during the war; it has improved greatly since that time. Prome was very unhealthy. Secunderabad was healthy, except as to one portion of the native lines. The healthiness of Secunderabad was an exception to the rule; it was to be accounted for in this way, that they got rid of all the grog shops about the lines, and that improved the health of the regiment immensely. They also established a lock hospital, which greatly reduced the number of the sick. The old barracks at this station are badly built, and they are huddled together on a low piece of ground; there is a great deal of broken ground in the neighbourhood, and that during the rainy season is very wet. They permit the natives to dig out and build their houses there, and the consequence is that every place where a house has been built is a receptacle for the water during the rainy season. From this one of the chief causes of the sickness arises. The 49th Native Infantry regiment suffered very much. The lines were not in such a position that any native corps could be expected to be healthy in; they were quite close to the tank—a tank about four miles long—in the rainy season, and the whole, with the exception of a made road lying between that and the barracks, was under water; the wind blowing from that quarter during the time of the drying up of the rains was sufficient to cause fevers. The men suffered very much from fever and guinea-worm. They obtained water from wells, not good wells, but bad, not deep enough. Kurnool is a very hot station; there is a great deal of small pox in that district. Jubblepore is a beautiful station, but very malarious. There is an immense jheel or marsh to the east of the station, and in 1858 they built barracks on high ground, but close to this jheel. Of about 120 men of the Europeans stationed there for some weeks, nearly all had the spleen very much enlarged. It admits of drainage, but the station is very badly drained, and the subsoil there is so wet that if you dig a foot or two underground you find water; it is a very sandy soil. The water is retained by something underneath the sand. Round the European barracks at Secunderabad the ground was remarkably well drained for a short distance in the neighbourhood of the barracks, but there is broken ground in the neighbourhood. All impurities are or should be removed daily by carts. With regard to the water supply in the lines of the 49th Native Infantry, many of the wells were very bad indeed at Secunderabad, they were almost dry, and there was a very bad supply of water there generally in the hot weather. It appeared to be of good quality, but the natives all suffered from guinea-worm; it was bad water. There are a great many animalcules in every description of water that is exposed in India. At Kurnool the men who took water from the river seldom suffered from guinea-worm. The barracks are very bad in many instances, the barracks at St. Thomas's Mount were very insufficient, and also the hospital, but it is improved since. At St. Thomas's Mount is a hill, and the barracks are placed immediately under it; in hot weather it is something fearful, the heat is so great. The sea is only four miles off, and they might have got the sea breeze daily. The old

Dr. C. Smith.

barracks at Secunderabad are very bad, but the new barracks at Trimulgherry are certainly the finest he has ever seen. There is no shade for exercise; the planting of trees in the stations would be a great advantage, and that should be done in every station. There are no sheds attached to the barracks for the purpose of enabling the men to take exercise. A few men take exercise either in the morning or in the evening, but not sufficient exercise. The natives take more exercise than the Europeans. There is advantage in allowing the soldiers to go out shooting, and they should always be permitted to go and enjoy themselves morning and evening when not on duty. They suffer occasionally from this, but the officers who go out shooting suffer no more than others who do not.

VENTILATION OF BARRACKS. 1406.

The ventilation of barracks by punkahs is not sufficient; each barrack should be well supplied with tatties to reduce the temperature in the hot weather.

ABLUTION ACCOMMODATION. 1420 to 1430.

Sufficient provision is made for personal cleanliness in the way of ablution rooms and bath rooms, but the soldiers do not take sufficient advantage of it. The English privates in India are the most dirty of men, he supposes, in existence; the common soldier generally washes his face and hands once a day; as a general rule, when they come to hospital, it is found they have not been well washed for a long time. The stations are not well supplied with baths, but with ablution rooms they are. The means of washing generally used in India are little chatties, or tubs, and the habit is to throw half a dozen of these tubs full of water over their heads in the bath room, and then they wash the body; but there are very few plunge baths, there are basins. The means provided for washing in the hospitals are sufficient, but they are not convenient. A sick man has often to sit on the ground in order to wash his face; there are no basin stands in the hospitals.

RATION. 1432 to 1434.

The rations are very good indeed. The contractors often try to cheat as much as they can, but generally the rations are very good indeed, and they are, he thinks, wonderfully well cooked. There might be more variety introduced in the way of vegetables. It is the fault of the regimental authorities if the rations are not good.

INTEMPERANCE. 1437 to 1458.

Spirits were served out as part of the daily ration in the beginning of last year in the field. The quantity allowed in the field is a dram twice or thrice a day. That quantity is too much, and it might be done away with altogether. Beer should be substituted. Has known cases where the health of the men has been injured by consuming merely the amount of spirits issued to them, especially when served in the morning, as many of the commanding officers have it served in the field. It is contrary to orders, but it is done. After giving spirits to them for a short time they cannot do without it. It becomes then a morbid habit with them. Thinks the old soldiers would grumble if they did not get their grog. It could not be done away at once with old soldiers, but in the case of a young man it might be done away with with great advantage to his health and efficiency. The recommendations of the medical officers are not always attended to; they are in some cases, of course; but in a case of that sort the commanding officer generally consults the men's tastes. A good cup of coffee should be given regularly the first thing in the morning. It is the rule in barracks to give them their coffee in the morning, and that should always be substituted for the dram in the field likewise.

MEANS OF RECREATION. 1459 to 1486.

The means of amusement or occupation are, cricket occasionally in the cool weather, fives courts, quoits, and long bowls. The amusements of the men are almost always connected with drink, more or less.

Dr. C. Smith. The amusement for the men is not enough, either mentally or physically. They often suffer in consequence from ennui. The state of things is very unfavourable to their health; it predisposes men to disease. Some commanding officers will drill the men morning and night; in the morning for hours, much too long for any constitution to bear, and they are exposed to the morning sun often; and in the evening they are often drilled before the sun has gone down sufficiently. There ought to be limitation as to the length of time that troops should be drilled during the day. If the soldier is sent out to India a good soldier, he might be drilled for an hour and a half in the morning, and for an hour in the evening, during the cold season; that would keep him in good training. That should be done four or five times a week in the cold season. In wet weather they should not be drilled at all. A good deal of indoor work might be done during the day in addition to the other duties. There should be workshops attached to the barracks where the different accoutrements might be made, or the clothing that is necessary for the regiment, &c., and gardens; those occupations would diminish ennui in a great measure. The want of occupation for the men is greatly felt. In India, there is nothing for a man to do except his duty. The men are not in the habit of reading much, it would be a great advantage if they were to establish a good reading room, and a library to be attached to every regiment. There is a very great deficiency in that respect. It would be a good thing to have such a reading room attached to the coffee shop where the men could also smoke.

DRESS. 1487. The present dress in India is a very good one indeed. The dust-coloured dress without a stock, a good helmet made of wicker-work well covered. Would have a light kind of flannel for the soldiers to wear for service.

CHOLERA. 1503 to 1518. An outbreak of cholera occurred in the Madras Rifles on the march. They marched at a most unhealthy season of the year, in May and June, when the wells were nearly dry, and the tanks in a like condition, and the heat as high as 119°. The water was very bad, bad to the taste and bad to the smell. The epidemic arose from that circumstance, along with the fatigue of the march and the temperature. It continued for about three weeks, but disappeared on the first rain. The regiment was broken up into two detachments, which seemed to lessen the virulence of the disease. Witnessed an attack of cholera amongst the native population at Prome in Burmah, and there everything was against the health of the natives, for it was surrounded by swamps, which in the rains were filled with water, and in the dry weather they were dried up. The town of Prome was very filthy. The people had their supply of water from wells. The dwellings were generally crowded.

CHIEF CAUSES OF DISEASE. 1520 to 1534. Attributes the largest amount of injurious effect upon the health of the soldier to a malarious climate, together with intemperance and syphilis. These are the three things which generally break up the constitution of a man in India. As regards these causes, the effects of malaria could be diminished in a great measure by a more careful choice of sites for stations. As to intemperance, the habit of serving out a spirit ration has encouraged it; intemperance may be diminished by substituting for the spirits an allowance of beer. As to syphilis should suggest the re-establishment of female lock hospitals wherever Europeans are in India, and a good set of peons or police to be attached to each hospital. A number of years ago in every station there were lock hospitals, but those were done away with, and only at a very few stations have they again got lock hospitals. It was false

modesty, he thinks, on our part. Had charge of one at Hyderabad. The commanding officer of the 3rd Europeans made this observation to me, "Your hospital has diminished mine by at least one-third since "its establishment;" but has heard that there was abuse of police authority. The report of Her Majesty's Inspector-General of Bengal was quoted by the Indian Government as influencing them powerfully in abolishing lock hospitals. The police at Secunderabad found out the women and brought them to the hospital; there were a couple of very good nurses attached to the ward, and they generally examined a suspected woman, and if there was anything the matter with her she was of course detained. There was no inspection made of others who were unsuspected of being afflicted with the disease. *Dr. C. Smith.*

Approves of hill stations. Was at Darjeeling in charge of wounded men. The men he took up were badly selected; but the men that should have gone up to the hills, he observed, soon became robust and strong, and by the month of October they were almost able to return to the plains again. The men who should not have been sent suffered from chronic diseases of the different organs of the body, men who were very far gone in phthisis, and dysenteric patients. Those cases were very much aggravated at Darjeeling; it was wholly due to the climate. It is damp and cold; but it is not an unhealthy dampness for healthy men. It is desirable to station troops in ordinary health at a considerable elevation above the plains rather than upon the plains, and on that account hill stations should be greatly increased in number; it would be an additional expense, but a great saving in the long run, for you would save your men's lives. But men who had been living previously in the plains would be the most fit for service during the hot seasons in the plains, for they would not come directly into the hot weather of that year. No corps should be kept on the hills during the very cold season. By occasionally sending men up to the hills for the hot seasons you can keep up their stamina; but if you keep them in the plains they lose that in a very few years; for this reason hill stations should be greatly increased; would bring the men down in the cold seasons for exercise on the plains. Coast stations are required for the men for certain classes of diseases. A sanitarium out of India is not wanted; men should be sent home if they are not fit cases for the hills or sea coast. HILL STATIONS. 1550 to 1581.

The arrangements of hospitals for European troops are not generally satisfactory, the native hospitals are generally very good indeed. The hospital at St. Thomas's Mount was very much crowded, in fact we had the men always in the closed verandahs, besides being in the centre ward. The old hospitals for Europeans were very badly ventilated, the new ones are very good indeed. The atmosphere generally in the wards towards morning is very bad indeed—very often impure, chiefly from overcrowding, in the old hospitals. In the old hospitals there was not sufficient provision for the sick, in the way of baths and ablution rooms. There is generally a number of natives attached to a hospital for removing impurities, and if the medical officer attends to cleanliness it is very well done. Has observed erysipelas in field hospitals in India, but not gangrene. HOSPITALS. 1583 to 1599.

The soldier's service in India should begin about 21 years of age, and he should be good for about 15 years in that climate, or between 12 and 15. It is the drilling of young soldiers of the age of 17 or 18 in India which kills them; the men should be drilled and made soldiers before sending them out to India. SERVICE IN INDIA. 1610 to 1617.

The medical officer should have a great deal more to say with regard to the sanitary improvement of a regiment than he has now, and SANITARY SERVICE. 1621 to 1628.

Dr. C. Smith.

sanitary committees should be appointed in all stations with a medical sanitary officer at the head. It just depends upon the commanding officers whether or not the recommendations of the medical officers receive attention. Has had two or three commanding officers who delighted to do anything they could for the benefit of the men's health.

Major-Gen. H. Goodwyn.

SANITARY CONDITION OF STATIONS. 1636 to 1717.

Major-Gen. HENRY GOODWYN, Bengal Engineers.

Has served at Kurnool, Neemuch, Jhansi, Cawnpore, Calcutta, Berhampore, and Bareilly. The country about Kurnool is generally flat, the canal runs close alongside. With the exception of the drainage into the canal itself there was none. There are no hills or elevated table land within a reasonable distance of Kurnool. Neemuch was excessively well adapted for drainage; it was an undulating country. Jhansi was a small station, and merely for a regiment of native infantry. In the case of Cawnpore, there was no inundation or irrigated land in the neighbourhood such as is likely to produce malaria. The position of the European barracks at Cawnpore is about the worst that they could have occupied, and they are positively, with the exception of the civil lines, upon the lowest spot of the whole ground. The horse artillery are in the best position, and the native cavalry; but the European infantry are placed in about the worst possible position that they could be. It is very difficult to drain, and the drainage from the bazaar, which is in rear, passes through the lines of barracks. The river is close to it, but a high bank intervenes, and very little attempt has been made to carry out the drainage from the barracks, which consequently was very inefficient. The hospital is rather nearer the river, upon a little higher ground, but still in the line of the drainage, and the drainage there is very offensive. Would condemn the infantry barracks at Cawnpore altogether, both on account of site and material. Cawnpore can be drained, and very well drained. The old barracks at Fort William were unhealthy, partly from their position, close under very high ramparts, and the absence of ventilation; partly also from crowding, for they were very much crowded. It is very difficult to drain Fort William properly; it could only be drained by means of the operation of the tide, and that not effectually. As regards Berhampore, attempts have been made to drain it more thoroughly. At all the stations there has been sufficient care taken to clear away the impurities and remove the ordinary drainage of the stations. It has been attended to by the establishment of the regiment, as far as he has observed, that is, as regards the buildings. Throughout India all refuse and impurities are removed daily by hand labour. No complaints of inefficiency in the service, from carelessness in the establishment, but more from the system itself; for instance, allowing large urine tubs to remain in the barracks the whole night, until the sweepers were allowed to come in the morning. In using large bamboos to remove a heavy tub they splash it over, and the offensive smell of the urine tubs would remain in the barrack for some hours afterwards. The tubs are made of a barrel sawn in halves; they are left in the barrack all night, and carried away by the sweepers in the morning. During the greater part of the night, while the men are there, there is continually a bad smell, remaining some time after they were removed. These tubs are particularly offensive on account of the high temperature. The urine is thrown into a drain at some short distance, or perhaps nullah, not very far off the barracks. The periodical flushing of drains about the barracks was left for the periodical rains more than anything else; the native

establishment used to wash them out, but this cannot be called flushing. The system has been generally to take as much care as possible in the formation of drains immediately around the barracks, and for a short distance from them, and then the matter has been left to take its natural course. Does not think that an eventual outfall has been provided. This accounts for what is called the difficulty of draining cantonments like Kurnool and Cawnpore, which are on flat ground. At Berhampore the barracks lie close to the river, and there was an effectual method of draining the whole square of the barracks into the river. The difficulty of Berhampore was that the interior of the square was lower than the highest point of the flood-rise, and an embankment alone kept it out. Water supply is generally provided in barracks by hand labour and water-carriers, principally from wells of various depths. At the lowest stations in the valley of the Ganges the water is near the surface. At Berhampore the supply was principally from the river. There was one plunging bath in Fort William, but only one. Baths were no part of the plan in the new barracks. The barracks at Cawnpore were of one story; those in Calcutta were of two stories; and at Chinsurah two. At Berhampore they were of three stories. At Dumdum there were both kinds, with and without upper stories.

Major-Gen. H. Goodwyn.

Proposes in building barracks to substitute iron for wood, and asphalte floors for the present lime and brick, thereby gaining an increase of width and space, an increase of height, and a more permanent flooring; it is impossible to keep a lime floor free from dust, and constantly breaking up, and it is also damp. Asphalte was laid down in the medical college hospital with perfect success, and in one of the store-rooms in Fort William, and timber was laid down upon this, and paper, and clothes, and many things, and they were kept free from the white ants, which destroyed similar materials when lying in other parts of the store-room that was not laid down with asphalte. Considers it an exceedingly valuable material, especially for barracks and hospitals. The floors in hospitals are generally the same as in barracks. Has had complaints as to the flooring being unsuited for a hospital. The hospital floors are renewed annually. This does not answer the purpose of keeping the place sweet and clean; for, with regard to a lime floor, when you have the smallest hole in it you cannot repair it. The moisture of the new material invariably gets in. Asphalte floors are a question of original expense, and that no doubt is greater, but they are less costly in the end. When the second quadrennial period comes round, almost all the woodwork in barracks has to be renewed. There is scarcely a bit of timber that lasts for eight years in Bengal. Light wrought-iron roofs and asphalte flooring are materials that can be taken away and removed, and they can also be kept lying in store in the magazines ready for the erection of barracks when required. Timber is never properly seasoned, and it all goes actually into the buildings with the seeds of decay in it. With reference to bricks, that is a matter to which very little attention is paid by the department. Nothing is more destructive to health than an imperfect brick building. The moisture which it imbibes is very great, and wherever the plaster decays and peels off, the brick absorbs the moisture, and therefore not only is the permanence of the barrack destroyed, but the men's health and accoutrements suffer. The plaster crumbles and powders both in the hot and in the cold seasons. There should be a better system of manufacturing brick. An engineer generally endeavours to make his bricks as cheap as he can, in order to keep his rates low; and he is therefore not so

CONSTRUCTION OF BARRACKS. 1718 to 1785.

Major-Gen. H. Goodwyn.

careful in regard to the preparation of the material as he might be. The section of the iron roof was like an H, on the lower flange of which a ceiling of corrugated iron was proposed, to be painted white, between which and the upper flange, on which rested the tiles, there was a hollow space of six or seven inches, which might either remain hollow, or be filled in with a non-conducting material. Would have a double iron door also, as the doors of wood are tumbling to pieces everywhere, and their frames too. Barracks in India are generally built of bad materials, that is, they are inferior, and susceptible of improvement if scientific men were sprinkled through the department. Objects altogether to the use of timber and grass for barracks. Has seen a whole regiment obliged to turn out into tents in the rainy season, from the barracks having been burnt down. Only knows one instance of barracks with arched basements, and that is in Calcutta; the absence of such arcaded basements is a great fault. The average central width of a barrack now is 24 feet, it is insufficient. Ventilation by punkahs is unsatisfactory; roof ventilation is very spare and scanty, and must be so particularly in pent-roof barracks. There are not sufficient means to remove the impure air. Advocates thermantidotes for forcing a current of air through a barrack room, on the principle of the fan blast, to remove the foul air, and lower the temperature. The air comes in through the sides of the machine which are filled in with tatty-work or grass kept constantly moist. The regulation as to space allowed per man in barracks and hospitals has varied from 800 to 1,000 cubical feet. There is not a question as to the advisability of having the barracks raised some 10 or 12 feet from the ground for keeping the barrack dry. If in rainy weather the soldiers had an arcaded place under the barracks for amusements, or to walk about in, they would be more comfortable and healthy than if they were shut up in a barrack room, or had the only alternative, namely, going to the bazaar for amusement. There have been separate cook-houses built with common brick and mortar. They are very simple in their arrangements for cooking; they are nothing but a series of brick and mortar receptacles for little iron gratings to boil and roast on; there are no stoves or anything of that kind, or grates. The introduction of asphalte flooring would be a material improvement in the cook-rooms, for the present floors are always dirty, and always broken. Petty barrack and hospital repairs are done at the request of the commanding officer of the regiment by the executive engineer of the district or the station; but there are periodical repairs for which he sends in a regular estimate to the Government.

HILL STATIONS. 1789.

Recommends a reduction of troops in the plains in the immediate vicinity of the hill stations. If there was an increase of barrack accommodation in the hill stations, and railways leading from the foot of the hill stations to the principal military posts in Upper India, great benefit would be derived in a sanitary point of view to Europeans. A small force in the plains themselves, and a larger force in the immediate vicinity of the hills, would be an advantageous arrangement. If there were rapid means of communication, that would be so well known that there would be no difference at all in the political aspect.

J. S. Roe, Esq.

JOHN SEPTIMUS ROE, Esq.

SANITARIUM IN WESTERN AUSTRALIA. 1805 to 1922.

Is Surveyor General of Western Australia. Resided there about 31 years. The colonists have always been of opinion that it would be a very favourable situation for a sanitarium for India, the climate

J. S. Roe, Esq.

being beneficial to the health of Europeans. It would require about 21 days by a sailing ship from Galle, which is at the south end of Ceylon, to the colony of Swan River. The steamers make it from Point de Galle to Swan River in about 20 days ; they ought to make it in about 14 or 15 days. Indian officers on sick leave made the voyage to Western Australia several years ago, before steam communication was established between the two countries ; but they were deterred from repeating their visits by finding that there was no regular means by which they could return, and it was of great importance to them that they should return at the expiration of their leave. If it were adopted as a sanitarium, probably the Government would see the propriety of laying on vessels of their own to go to and fro between Galle and the Swan River, or wherever the sanitarium might be established. The occupied part of the country is about 560 miles north and south, and perhaps 250 east and west, in round numbers. The heat in summer does not approach generally 100°. The greatest heat id the shade under ordinary circumstances would not be more than about 92° or 94°. The lowest temperature is about 45° ; but it is below the freezing point at times. There are hills from 1,500 to 2,000 feet from 10 to 20 miles from the coast generally. The cost now of keeping a man is considered to be about 22*l.* ; he may be found with the necessaries of life for that. Convict labour would be available for barracks, roads, &c. There is room now to accommodate a couple of thousand convicts well. There is an abundant supply of water for all domestic purposes. As cultivation and clearing have extended, the water has burst out. The building materials are good stone and lime, bricks and timber (jarrah) of the first quality. There is no difficulty in obtaining access to the anchorages at any time of the year, and no difficulty in vessels of any size coming in. It is not unsafe to go out in the sun ; but for the sake of comfort umbrellas are sometimes used. There are about 10 or 12 days in the course of the summer during part of which a man would not work in the sun if he could avoid it. In winter there is an abundance of rain, but not tropical rains. The winter would be more invigorating and refreshing for invalids, the summer heat being to be avoided if possible.

Dr. JONES, Staff Surgeon, late 77th Regiment.

Dr. Jones.

SANITARIUM IN WESTERN AUSTRALIA. 1923 to 2007.

Was four years in Western Australia. Had charge of one of the largest depôts in India. From the opportunities of witnessing the effects of the climate of Australia on Europeans, considers it one of the best adapted for invalids from India. The advantages belonging to the climate are freedom from malaria, except where it arises from preventable and local causes, and a generally uniform temperature. The system of invaliding in India at present is only once in 12 months, and sickly men are obliged to remain in the country until the invaliding period arrives, when they are sent home, if required. Now, if a colony were selected like Western Australia as a sanitarium, men might be removed at all periods of the year. This would afford relief, and give sufficient tone to their constitutions to enable them to endure a further residence in India. Depôts would be reduced, most of which contain sick of various corps. That object would be more effectually attained by a sea voyage and subsequent residence in Western Australia than by sending men to the hills in India. The conveyance might be effected by Government vessels. The hill stations are more or less damp, while the atmosphere of Australia is dry. The mountains of India are more useful for the preservation of health than the cure of disease. The

Dr. Jones.

curative influence of the climate of Western Australia would probably apply to all or to almost all the diseases of India. Suppose a man to have suffered much from fever, and the fever is still latent in his system, the effect of crossing the line and entering into the south-east trade is to induce a disposition on the part of the fever to lose its periodicity, while if he remained in India the fever will still adhere to him. The physical character of the children of the residents in the colony is very good, though they are certainly not so fine as the children at home; they have not the same development, otherwise they are perfectly healthy. They are not subject to visceral disease, as the children of Europeans who have been brought up in India are.

Maj.-Gen. F. C. Cotton.

Maj.-Gen. FREDERICK CONYERS COTTON, Madras Engineers.

BARRACK CONSTRUCTION. 2008 to 2035.

Has been constantly employed in inspecting amongst the military stations in the South of India, and has discussed continually all the peculiarities of the different barracks. Believes that the Neilgherries will be found the very best home for Europeans in all India; they are much more open than the mountains in general, not so precipitous as the Himalayas, and everywhere more level and habitable. In the Neilgherries there is no actual flat, but the country is not precipitous, and roads can be opened with facility throughout the country. Troops are quartered there the whole year round; it is out of the very rainy portion of the hills, and the site was chosen partly on that account. On one occasion the wing of a regiment had been in temporary barracks for six months. The position of the buildings was good, but the rooms were so confined that any one would have thought it injurious to the health of the men, yet only three per cent. were on the sick list. The men were living apparently a healthy life, very much out in the open air. In the new permanent barracks a very undue importance was set upon the height of the rooms. The cubical content of air is calculated by the height, length, and breadth being multiplied together, so that the same value is given to the air high above the men's beds as that on the same level with them. This is fallacious, as the air immediately near the men must be of much more importance than the air far above them. It would be well to have the barracks so constructed that in case of emergency they might be capable of holding more men than they ought to contain under ordinary circumstances. Where the cost is excessive, as in India, it would be better if less money had been spent in the height of the rooms. Such ventilation might be given as would be quite sufficient if it were well contrived, so as not to affect the temperature materially. There is more or less jungle and dangerous country on all sides at the foot of the Neilgherries. On the south, including the pass, it is 20 miles broad. On the north the breadth of unsafe country is about 25 miles. On the west the dangerous country could not be passed under 20 miles. When the thing is thoroughly done there will be very little additional cost in maintaining troops at that station, because they may have the cattle bred and all the vegetables grown on the hills; but in a transition state it must of course be more expensive, as everything has to be obtained from below. That is not the case in all the hill ranges of India. When new hill stations are to be selected it would be very advisable to have temporary buildings erected for Europeans, so as to test the climate.

IRRIGATION. 2038 to 2051.

Has carried out works of irrigation in the southern portion of India, in all sorts of soils. We have two distinct kinds of works, one in which we keep the water in reservoirs, and so cultivate, and the other in which it is turned from the river without storing it. The surfaces

of whole deltas are kept flooded for the greater part of the year, and are dry during the other part of the year. Works are carried out near large cities and stations, such as Trichinopoly and Bangalore ; in Madras irrigation is carried out in almost all places wherever we have European stations. In Southern India we know nothing of ill effects to health from irrigation. Officers who come from the northern parts of India say that the people of that country suffer from spleen and other diseases arising from malaria ; but we have nothing of the sort. Works of drainage are very indifferently combined with works of irrigation. The water lies upon the ground during the growth of the crop. It would be very advisable no doubt to be very careful of drainage in countries where fever was caused by irrigation. Our experience led us to suppose that *excessive* and continuous heat made countries more safe from fever. We consider that irrigation improves the climate of hot stations, by making them cooler. *Maj.-Gen. F. C. Cotton.*

Would occupy every hill station with Europeans, which was not actually proved to be unhealthy. Hills of a moderate elevation are to be found almost everywhere within two or three days march of an existing station. Every year seems to prove that you have some range of hills within reach of you ; there is hardly any province without some hills. In the Mysore country there are ranges of hills, with fine climates, almost every one of them. In forests fatal fevers are very local, the malaria or whatever causes them being confined to narrow spots. Was led latterly to conceive that the form of the ground had much to do with it, as the poison became condensed and increased in strength in places from which it could not flow off or the wind could not disperse it. Has little doubt that surrounding trees form a tank for malaria in many cases ; hence the danger of close belts of trees about buildings even in the open country. There was only one place in which the water was bad in all that country. The particular point was at the foot of the Neilgherries, near Seegoor ; there was a stream from the hills there, which all the doctors thought was poisonous ; that was the only case that was established, but the natives attribute everything to the water. There is no way of testing the climate of the hills but by actual trial. There are places where a fine healthy population of natives live which are decidedly dangerous to strangers. If the inhabitants suffer from fever there is no doubt that strangers will suffer ; but their exemption from fever is no security to others, though it may give fair promise of the climate suiting Europeans. There is one range which has deceived everybody—Shevaroy Hills, near Salem, which seem perfectly healthy for years together, but have been visited at long intervals by violent and even fatal fevers. After first opening the ground mischief follows. Hong Kong the first year after it was opened was most deadly. Since that it has never been so bad. In healthy situations newly cultivated land has not led to sickness in the South of India. Stations anything like 6,000 feet elevation might boldly be tested if the extent was considerable, and the forest not dense, and you might very boldly go to 2,500 feet, but there are hills of 2,500 feet in elevation, the spurs of greater hills, on which he would not venture, but for all that local knowledge is the only guide. There is a sort of general idea that where there is much higher ground near at hand the spurs are not so safe as the highest table lands. HILL STATIONS. 2055 to 2080.

In the Godavery works had about 20,000 men at work, and about 40 Europeans, and experience there went to prove that the exposure did little or no harm to the men who led temperate lives. If men are to be in a hot climate they are better employed in the open air than confined to buildings. OCCUPATION OF MEN. 2083.

Maj.-Gen. F. C. Cotton.

EXPERIENCE IN CHINA. 2087 to 2091.

Was with the army in China for two years, constantly changing places. They were sheltered chiefly in native buildings requiring only to be altered to suit the purpose, and the experience was valuable in every way, for nothing could be more unsuccessful than we were, at first, in the treatment of the army. The army was for many months ruinously mismanaged. There was an epidemic in the country which took a most fatal form with the army in Chusan. The same disease ran through the navy, but the men being well fed and well sheltered, few, if any, died of it; whilst the 26th Cameronians were almost destroyed by it. They were not actually placed in a marsh; but there was low land about the camp, and many of the men were for a length of time in open buildings, in a pillaged town, with the contents of the shops thrown out and rotting in the drains of the streets. The provisions brought from India with the army had become unfit for use, and no steps were taken to procure fresh meat for the soldiers, whilst the navy demanded and obtained fresh provisions from the Chinese inhabitants of the islands, and the epidemic proved in general harmless with the sailors.

In the modern Indian barracks great trouble has been taken to make the arrangements for removing impurities satisfactory. In the old barracks there is comparatively little done, but the hill stations generally have great advantages in that respect, the rapid fall of the land facilitating the drainage from the barracks.

EFFECTS OF SOILS AND SUBSOILS. 2096 to 2103.

As regards the influence of particular soils on health, laterite has ingredients of granite; iron is also one of the great ingredients. It is not associated with the prevalence of fever. The subsoil at Bangalore is a white granite rock which splits in slabs of any length and is used for building; the rock is very near the surface. At Chusan the rock is similar to that at Bangalore. It is very important that some further and systematic inquiry should be made as to the causes of fever in India. The districts in which fevers prevail, and the confined spots in which they are fatal, are now in so many cases well known that it is highly probable that a careful investigation and comparison would lead to a detection of the source of the evil, and the cause of the poison being so much more virulent in certain places, and those frequently of very limited area. There are many ailments which the natives call fever, but which a medical man does not, which are the effect of malaria. They have colds and chills which do not appear to be the effect of malaria, but which they call fever. Jungle fevers are unmistakeably the effect produced by some poison, and people have been known to die of them in a few hours. Has known a man die in nine hours from the time he was attacked. Fatal fevers are found at all levels from the level of the sea to the height of 4,000 feet, and they have occasionally appeared higher still in the Neilgherries, but when this has been the case the place affected has been at the head of a ravine leading from a fever jungle. Hill stations should be placed only in open valleys, if possible, where there should be a free circulation of the air about them, with no jungle immediately near to the station. There are just as bad fevers where there are no jungles; but still, for the sake of ventilation, it is better not to have stations in crowded places. There should be a free circulation of air and a good supply of water. An abundant supply of water ensures your having the place clean, as drainage is affected by that only.

CURE OF FEVER. 2115 to 2118.

The secret and right of manufacturing "Warburg's fever drops" should be obtained by purchase. Those engaged in opening the passes through the fatal jungles of the western coast of India have found that medicine invaluable. In the Perambaddy pass especially, a

Maj.-Gen. F. C. Cotton.

trial of it was made on a very extensive scale, and with admirable results. When its efficacy became known, the coolies employed would work in the most dangerous parts of the forest, if they were sure that the medicine was at hand. After a long experience of its efficacy, has no hesitation in saying that it is a most valuable medicine, and ought to be in every hospital and camp in India. It affects so immediately those fevers on the west coast, that has had a man who was barely able to swallow it cured in a few hours by it. The effect of it is to produce violent perspiration almost in all cases. It is a very expensive medicine, costing something like 10*s.* or 12*s.* a bottle, which contains a single dose ; here, it costs, I think, about 4*s.* A second bottle had never to be given.

T. Longmore, Esq.

THOMAS LONGMORE, Esq., Deputy Inspector-General of Hospitals, Professor of Military Surgery at the Army Medical School, Netley.

SANITARY CONDITION OF STATIONS. 2131 to 2171.

Was three months engaged as head of the sanitary department in the Inspector-General's office at Calcutta. Served altogether a little under two years in Lower Bengal with European troops : at Calcutta, Barrackpore, and Dinapore ; also for a short time at Dumdum. The three stations are situated on very low ground. In regard to Calcutta, the general sanitary condition of that city is well known. Fort William is an unhealthy station, partly in consequence of its being placed within a fortification, and partly from being on low ground in the neighbourhood of the river, and from that part of the river near the Fort being very densely crowded with shipping ; and also from the effects of imperfect drainage, in consequence of the flatness of Calcutta, and the habits of the natives in the bazaars, which, in one direction, are at a comparatively small distance from the fort, and many other circumstances. The sanitary regulations and the conservancy arrangements in the fort are as thoroughly attended to as they can be, and much more could not be done to improve the sanitary condition of Fort William, keeping the military necessities of such a fortress in view. At a short distance are the Colinga, Durumtollah, and Bow Bazaar neighbourhoods. The influence in certain winds of these place is quite perceptible at Fort William, although there is a very good esplanade between the fort and those bazaars. And as regards the chief part of this extensive city,—that inhabited by the native population,—the pestilential condition of the surface drains, and yards, and many of the tanks among the huts and houses, would not be credited by any one who had not been among them. There is no doubt there would be much more mortality among the troops were they not to some extent separated from these influences by the open space surrounding the Fort. Whatever may be done, Fort William will always be unhealthy for troops. Barrackpore is a very superior place, in a sanitary point of view, to Calcutta. It is more open and better ventilated. From various circumstances, the atmosphere is purer. The river is a mile in width at Barrackpore, and is quite free from shipping, and with a good current. Then, the drainage at Barrackpore, although not so good as it might be, is still much better than it is at Calcutta, and, of course, being a military station, the general conservancy is more under control ; and the native bazaar, which is near the station, is always kept in good order from being under military supervision. In the neighbourhood of Fort William the shipping is very densely packed, and in many ways a source of great mischief, not merely as an obstruction to the atmosphere, but from the amount of filth that is accumulated about them. It

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constantly happens that the corpses of the Hindoos get entangled among the vessels, and in several instances it has been almost traced that in particular ships little outbreaks of cholera have taken place from the effluvia arising from bodies which have become entangled in the anchorage of the ships. It would be a wise economy if the Government were to supply the fuel necessary for this purpose to the burning ghauts. The Soonderbunds contain an endless supply of wood fit for the object, at no great distance off. There are muddy banks alongside, most particularly where the shipping is densely crowded, as it is about Calcutta. In clearing out a portion of the Fort ditch into which the drainage of the Fort was chiefly carried, an enormous accumulation was found to have occurred at the bottom, and upon exposing this, with a view to its removal, fever occurred, apparently attributable to the emanations from this accumulated matter. All the barracks in Fort William, both the old and the new, are raised upon arched basements. In Fort William the water is ordered to be obtained from a tank outside the fort, which is generally known as the Havildar's tank. The well water within the Fort is very objectionable, and there are positive orders that none of it shall be used for drinking purposes. It requires a good deal of watching to see that the bheesties do bring water from the Havildar's tank, as it is some distance off. A great deal of water is drunk ; spirits they obtain by purchase at the canteens. An attempt is now being made to establish a company for the purpose of bringing purer water to Calcutta. The water for purposes of cleanliness is simply brought by bheesties, who fill the chatties or vessels. The method might be improved. There was no bath in Fort William, and the establishment of one would have been a great benefit to the troops.

GREAT MORTALITY AT DUMDUM. 2172 to 2179.

Was stationed at Barrackpore when so much sickness occurred in the general depôt at Dumdum in 1858 ; and was on the commission of inquiry which was ordered to assemble in consequence. Our inquiry went over five months, and during the period of five months the rate of mortality among the children was at the rate of above 50 per cent. per annum, and among the women above 27 per cent. per annum. There were in five months 64 deaths out of an average monthly strength of 554 women ; and there were 166 deaths out of an average monthly strength of 770 children, or in other words an average annual percentage among the women of 27·60, and among the children of 51·60. The average for all Bengal, according to most authentic documents, was at the same time, of women 4·45 ; and of children 8·41. The diseases which caused that mortality were dysentery, fever, and cholera. We traced the visitation very distinctly to a series of causes, such as overcrowding among others, and to a neglect of all sanitary arrangements. The women were detained there on their arrival from England and elsewhere, their husbands being sent up country during the mutiny.

DINAPORE. 2181 to 2207.

Dinapore has always been found to be a very unhealthy station, and this has been chiefly owing to the construction and the arrangement of the barracks, and their immediate neighbourhood to a populous native bazaar. To some extent it has also arisen from the effect of the overflowing of the Soane river, and a large nullah which goes round the station of Dinapore. This nullah, during the rainy season, is full from the river Soane, passing along it into the Ganges, but at other seasons it is left low, and at a little distance from the barracks becomes the receptacle of all kinds of filth. In the immediate neighbourhood of the cantonment it is looked after, but at a short distance it is a place of deposit for every kind of filth, and under the influence of certain winds certainly produces bad effects upon the inmates of the bar-

racks. The barracks have been reported for many years to be as badly constructed, and are as badly placed with regard to the arrangement of them in squares, as any barracks can be. Moreover they are very little raised above the ground, and in the morning, or after sunset in the evening, you may see, if there is not much air stirring, a dense vapour just resting on the surface of the ground within the several squares, while above this vapour, or a little below it, the air is apparently quite free from anything of the sort. The vapour carries with it malaria, and in many other ways it is also very injurious in a tropical climate. Much of the disease which has taken place there might have been avoided by merely raising the buildings upon arches, so that there might be a free circulation of air beneath the inhabited story ; and by not having them constructed in quadrangles. The new barracks each contain a company. They are badly arranged, in parallel lines, so that one shuts off the wind from the other. As an illustration of the advantage of the recent sanitary arrangements of the Queen's medical service in India, it may be stated that, as sanitary officer, one of the first steps taken at Barrackpore by him was to report against a proposed arrangement of barracks in parallel lines. A committee was ordered. In consequence the plan was altered, and the buildings were placed *en echelon*. If it had not been for this incident the barracks at Barrackpore would have been all constructed as they are constructed at Dinapore, in parallel lines, one shutting off the air from the next. Temporary barracks are built of two kinds of bricks ; the portions on which the weight of the roof rest are built of kiln-burnt bricks, but the main portion of the walls is built of sun-burnt bricks. The floor of a temporary barrack is very little raised from the ground, and it is not hollow underneath. They are calculated to last about four or five years. It is not unlikely they may be occupied for 20 years. A very great proportion of the enormous rate of mortality at Dinapore may be ascribed to a defective arrangement of the barracks. Has been told by resident civilians there that the health of persons in the neighbourhood of the station was very fair, and that they themselves enjoyed good health. The mortality might be very greatly diminished if the first principles of hygiene could be enforced in the vicinity of the station, and if the troops were properly housed, and healthy exercise and recreation encouraged, with proper protection from the sun during the hot months. Under no circumstances ought the old barracks to be occupied.

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During the mutiny medical officers were charged with sanitary duties, but since the mutiny the office of sanitary officer in the Inspector-General's office has ceased : there have, in fact, not been officers to carry it out. But it was leading to an immense amount of good, because it called attention at once to any circumstance that was calculated to be prejudicial to the health of the troops in a station. Many instances of advantage arose from this early notice of probable sources of sickness during the short time that he was acting as sanitary officer. Officers of long standing in the Indian service stated that their system of sanitary reports was a failure ; that they were only made yearly, when either the mischief was over, or the thing had been remedied. Our practice of making a weekly report was very advantageous, and in many instances it led to a very great deal of good. Sometimes difficulties arose from medical officers going the wrong way to work about things, but as far as possible they were soon put to rights, and mischief was prevented, and good done. By virtue of the new regulations, a medical officer, if he sees a source of disease a mile off, or at any distance, is directed to call the attention of the commanding officer, not merely of his own

Sanitary Service. 2209 to 2216.

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regiment, but of the station, to it, if there be no senior medical officer there. He is directed also to make the head of his own department acquainted with whatever he does in this way. If the returns in the Medical branch of the Inspector General's office were showing that there was an increase of disease in any station, such as had not been before noticed, immediate inquiries would be made through the sanitary branch, to trace, if possible, the disease to its source, and to ascertain how it could be remedied. The new medical regulations and the instructions given to medical officers as to sanitary matters in barracks and stations when in the field or in camps are equally applicable to India.

CAUSES OF MORTALITY AT DUMDUM. 2218, 2219.

One source, no doubt, of a great deal of the mischief which occurred at Dumdum in 1858 was to be traced to effluvia from the latrines reaching the barracks. The effluvia from the matter in those latrines did reach the married quarters, and at the time of our visit they were exceedingly offensive; the whole arrangements connected with the latrines were very bad, quite unsuited for women and children. Then the urine was found to have been constantly thrown out into the open drains, and on the ground all round the barracks, creating additional effluvia. Such matters are of vital importance in a tropical climate, where decomposition progresses with the most wonderful rapidity, and disease itself is so prolific; but they are not generally considered to be of so urgent a nature, excepting by persons whose attention has been specially attracted to the subject. Could mention many instances in proof of these statements.*

Dr. W. C. Maclean.

Dr. WILLIAM CAMPBELL MACLEAN, Deputy Inspector-General of Hospitals, Professor of Clinical and Military Medicine, Netley Military College.

SANITARY CONDITION OF STATIONS. 2224 to 2314.

Has served 22 years with native troops, and also with Europeans, both in Her Majesty's service and in the Indian army. The stations in the Madras presidency have been selected not at all with regard to medical considerations; many of them were occupied merely because they happened to be the spots where the troops first pitched their camps upon taking possession. Accident and political considerations have had a great deal to do with it. Until lately the questions whether the soil was good, whether the water supply was sufficient and of proper quality, and whether malaria prevailed, were never thought of at all. But there has been more attention paid recently. Is strongly of opinion that it is possible to remove troops—perhaps not from all—but from a great many stations on the plains to the hills. In Southern India every province has its hill range. The Shevaroy hills are about 190 miles from Madras. There is a railway to the foot of the hills. Troops stationed on those hills might be considered as being within one night's run of Madras by rail. There is a station on the Neilgherry hills formerly called Jackatalla and now called Wellington, at a height of above 6,000 feet, and about 300 miles from Madras by the road *via* Salem. In a very short time the railway will go to Coimbatoor, which

* In a paper appended to Professor Longmore's evidence, the following causes of the great mortality among these women and children are given:—The principal mortality has arisen from cholera, fever, and bowel complaints. The general causes which chiefly engendered and fostered the unusual sickness and mortality were the following:—Intemperance and immorality, reckless exposure to the sun, indulgence in unwholesome articles of food, want of personal and general cleanliness, and breathing an atmosphere polluted by overcrowding and other causes. Some of the witnesses described the atmosphere of the barrack rooms at night to be so extremely offensive as to be perfectly overpowering on entering them.

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is almost at the foot of the ghauts, one night's march from the hill station. The nearest hill station, which can scarcely be called a hill station at all, for Secunderabad, is Beder, 2,000 feet high. There is also the hill of Ramandroog, at Bellary, the height of which is over 3,000 feet. But this is at a very considerable distance. There is besides a range of hills; the Gallicondah. Bangalore is about 3,000 feet above the sea, and within three days reach of the Neilgherries. It is a healthy station; but there is a good deal of liver complaint in Bangalore from hot sun and cold wind. The temperature is comparatively low all the year round, except for about six weeks. It is such that Europeans can take exercise, and they live almost in the open air. Trichinopoly is the hottest station upon the plains. Men stationed there are exposed to the deteriorating influence of continued heat. The Neilgherries, for all practical purposes, are available for Trichinopoly; when the railway is open from Trichinopoly to Coimbatoor the Neilgherries will be within a day or a day and a half's journey of Trichinopoly. Would abandon Trichinopoly as a station for European troops, because of the distance being so trifling. Instead of keeping a strong regiment of 1,000 or 1,200 men in such a hot station, where their health deteriorates, would leave native troops there, being ready to reinforce them by Europeans from the Neilgherries; and use the Neilgherries not merely as a sanitarium, but as a station. For Cannanore the Neilgherry hills are conveniently accessible. Instead of the station at Bellary a force should be maintained at Ramandroog in the immediate neighbourhood. Ramandroog is a detached hill. There is not a great deal of available ground on the top of it; but still there is quite enough to furnish supplies for a wing at all events. Waltair is the most salubrious station in the northern division of the Madras presidency; it is a small elbow of land that juts into the sea, having the sea on three sides of it, and backed by a high range of hills, which completely cuts off the land wind. The northern division is the most feverish district in the Madras presidency, but at Waltair there is rarely any fever at all, and such cases as do occur are mild; it is, without exception, the most healthy station in that part of India. There are many cases of disease at Secunderabad, chiefly bowel complaints, that cannot be sent to the hill stations; and it is believed that they will do well at Waltair, for it is on the sea coast. Not only will Waltair be useful as a sanitarium, it will be a very important position for the head quarters of a regiment, as it is conveniently placed for embarking a force on an emergency either for Pegu or Calcutta. Pondicherry is comparatively a healthy place, and the sanitary arrangements are very much better than those at Madras. It is not so crowded a city as Madras, and has not a tenth part of that population; there are fewer dead buried in Pondicherry; the burials among the living in Madras are very great; the wells are polluted by organic matter, and this exercises a marked influence on the health of the people, particularly in the district of Triplicane; but the drainage of Pondicherry is very much better than that of Madras; they have less cholera and fever there, and they have fewer bowel complaints; all tropical diseases there are in a milder form, and are more manageable than in Madras. The water supply is better than in Madras, and there are good natural facilities for drainage. At the station of Beder, where cholera has never obtained a footing, there are good natural facilities for drainage; the soil is laterite. In the greater part of the Nizam's country it is granite, a great part of it in a state of decay, and we know that wherever stations are situated in places where the granite is in a state of decay, those places are not healthy.

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IRRIGATION. 2318 to 2320.

Has always understood that when irrigation operations are first commenced, and large quantities of the soil broken up for the first time, the result has been a considerable amount of ill-health, fever, and bowel complaints produced by the operation of digging and turning up the ground. Has never heard of any evil as resulting from the application of the water, or that the people suffered; but, on the contrary, that their condition in every way improved.

SANITARY CONDITION OF WELLINGTON AND SECUNDERABAD. 2336 to 2340.

In all experiments made upon the hill stations the Government are apt to be discouraged by first trials; for instance, at Jackatalla, which is now called Wellington, when the troops were first sent up there, the Government were much disappointed at the result; bowel complaints prevailed to a very great extent; the sickness was considerable, and the mortality heavy, but the troops were sent up before accommodation was sufficiently prepared for them, and there were upwards of 2,000 or 3,000 workmen, who were employed in the construction of public buildings who were under no sanitary control whatever, nor were any arrangements made with regard to them, to make them keep the ground clean, so that for miles about the place was one immense privy, and the consequence was, that when the troops went there, bowel complaints prevailed to a very great extent, and it was long before Government became reassured. But now that sanitary arrangements have been carried out, and that the buildings have been completed the sickness is considerably under 1 per cent. This is not an isolated case, for when the magnificent barracks at Trimulgherry were being erected, the very same thing occurred. There were thousands of workmen employed, under no control, and the whole place was in the same condition precisely as the other. When those barracks were first occupied by troops, bowel complaints prevailed to a very great extent, and all those who had taken an active part in condemning the old barracks were very much jeered at in consequence. The very high rate of mortality (60 per 1,000) among Queen's troops at Secunderabad is attributable to the prevalence of the most malignant form of dysentery; but that has been almost entirely confined to the old infantry barracks. The artillery of the Indian army, with a mortality of 25 per 1,000, were never quartered there; they occupied barracks on the higher ground; the infantry barracks at Secunderabad were situated in a basin, and the ground on one side was deeply furrowed by nullahs; it was, in fact, the watershed of the neighbourhood, and these nullahs were generally resorted to by all the people in the bazaars and the neighbourhood, and the sanitary condition of the place was bad all along. The barracks themselves were of a very faulty construction, and they were always overcrowded. When he first went to those barracks with the Queen's 55th regiment, which was a regiment at that time of nearly 1,200 strong, they were crowded and stowed away in a barrack that was originally constructed for 700 men, and dysentery prevailed there all the year round, more or less, but more particularly after the rains, and when the ground began to dry. In certain years there were very frightful epidemics, which carried off a large number. The barracks at Trimulgherry have never yet had a fair trial; the intention was that the enclosed verandahs were never to be occupied by troops, but owing to the pressure at the time of the time of the mutiny, there was an entire regiment of dragoons, and a considerable portion of a regiment of infantry, quartered in them, and the consequence was that the verandah, which ought never to have been used as a dormitory at all, was invariably occupied as such, and the soldiers who lived in the centre dormitories of the barracks suffered

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at night from the respirations of the men occupying the outer verandah, and thus, in my opinion those barracks have never yet had a fair trial. Sir Patrick Grant has urged upon Government the necessity of abandoning the cantonment of Secunderabad altogether, and moving it out between Trimulgherry and Bolarum upon the same ridge upon which the new barracks now stand.

Chief Causes of Mortality and Sickness. 2350 to 2355.

The chief mortality in all tropical stations is made up from dysentery, cholera, liver complaints, and fevers. The main cause of the sickness among Europeans has been the overcrowding and bad ventilation in barracks. Speaking of remediable causes, those were the master sins of our old system. Until very recently arrangements for preserving cleanliness did not exist at all. For instance the Fort of Madras is situated within a few yards of the sea, and the highest part of Black Town, immediately in the rear, is not above 20 feet above the sea, the whole of the drainage of Black Town passes in immediate contiguity to the Fort; the place is so level, and the supply of water so bad, that the drainage there is, perhaps, worse than in any town either in the tropics or in this country; and the consequence has been that both the residents living in the Fort and the natives have suffered severely; sometimes officers and gentlemen employed in the public buildings in the Fort have almost been made to vomit by the intense and abominable smells from the drains, and they have, no doubt, been a source of very great sickness in Fort St. George; but now that has been to some extent remedied. A few years ago there was a very high sea wall, which ran 500 feet along the sea face of the Fort, with casemated batteries, but Sir Charles Trevelyan had it thrown down, and the sea face is defended by a low wall, with heavy ordnance mounted en barbette, and that has had an immense effect in improving the health of the fort, for the sea breeze penetrates through every portion of it. The barracks are also greatly improved. Sir Charles Trevelyan had verandahs added, he had the officers' quarters moved, and the men, who were intensely crowded on the ground floor, were moved up into the upper story, and a great many sanitary improvements of a similar kind were carried out; and immediately, as if to test the benefit arising from these improvements, we had a very severe attack of epidemic cholera in the town; not a single case of cholera appeared in Her Majesty's 43rd regiment then quartered in the Fort at the time, while no epidemic of cholera that has prevailed there for the last 20 years ever before passed over Madras without taking its victims out of the Fort barracks. The only part of the barracks where the accommodation was not improved was the patcherry, where the married men live. There the married soldiers with their wives were undoubtedly crowded, and they suffered a little. There were one or two cases of cholera in the patcherry, but not one in the improved barracks. The habits of life of the European soldier in India are very unfavourable to health; for undoubtedly they are very intemperate, and they suffer much from *ennui* and from want of occupation. Has never seen a regiment where those matters have been attended to, in which the results were not beneficial.

Hill Stations. 2356 to 2359.

There is a very large class of diseases that cannot be sent to the hill stations; for example, bowel complaints; on the Neilgherry hills we were obliged to send the majority of the sufferers from bowel complaints and hepatic affections to Europe, or to the sea coast. Mountain ranges are not so much places for the cure of disease as for the prevention of disease. The want of facilities for the easy transport of invalids from up country stations has always been a cause of mortality. But they are now organizing bullock conveyances, and invalids are sent from the

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up country stations by this transit system to the sea coast. Unquestionably much mortality occurs from the want of means to remove men from India at an early period of disease. The station of Waltair would be of immense benefit to the soldiers at Secunderabad ; in a very few years it will become the established practice to send men who are convalescent after severe dysentery down to the sea coast. The severer cases must go to sea.

BARRACK CONSTRUCTION. 2374 to 2386.

Comparing the men living in the patcherries, and the men in the old barracks, bad as the patcherries were, we never had the same mortality there that we had in the barracks, in neither their families nor themselves. The married men in the patcherries enjoyed better health than the single men in those bad barracks. The men had better health there than their comrades in the barracks, because they were not poisoned by one another. Soldiers ought to be all in separate buildings. The system which now prevails in India of erecting costly palaces for troops is one of the most unfortunate mistakes that was ever made, because in the first place, the barracks are so costly that the Government grudges the space required for the men, and if such barracks were built as Colonel Durand knows were erected at Moulmein, detached bungalows, well raised from the ground, and well ventilated with roof ventilation, the health of the troops would be enormously increased, and the Government would save an immense sum of money. The officers live in detached dwellings, and the mortality among them is not half so great ; the mortality at Secunderabad rarely exceeded two per cent. among the officers. Barracks ought to be placed *en echelon*. A building in India which consists of two stories of barrack rooms can never be properly ventilated ; natives never live together in large dwellings.

INTEMPERANCE. 2390 to 2404.

Spirit drinking is sometimes caused by the bad sanitary condition in which the soldier is placed. In bad circumstances he drinks, because he has nothing else to do, and when once the habit is contracted, it is difficult to cast it off ; in some regiments the difference is enormous. The 84th regiment, which was under the command of Colonel Russell, was an Irish regiment, and it was very much under the influence of the Irish priests, who were promoting the temperance movement at Secunderabad ; there was scarcely a man that drew the spirit ration, and, as might be expected, it was one of the healthiest regiments ever seen at Secunderabad. Again, saw the 26th Cameronians under the command of Colonel Oglander ; they were 900 strong when they joined us in the expedition to Chusan ; when they landed at Chusan there was not a single man in the regiment, except the old soldiers, who drew his spirit ration. Up to the time of their landing at Chusan their health was admirable, but the regiment was completely destroyed at Chusan, because they were fed upon putrid meat which had been cured in Bengal, and because they were badly located, and badly cared for after Colonel Oglander's death ; the regiment was completely destroyed in two months ; they could not muster 20 men. Where officers like Colonel Russell and Colonel Oglander, having great influence over their men, turn their attention to these matters, they produce most beneficial effects in their regiments. Much of the sickness which prevails in India is due to debauchery. Some steps should be taken upon that subject ; the loss of efficiency from syphilis in India is now becoming quite a State question. A short time before he went to India there was at every station a lock hospital, but a prejudice got up against them. They were either thought expensive or inefficient. In the 1st Madras Fusiliers a few years ago, 368 cases of syphilis were admitted into

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hospital ; this caused 8·456 days of total loss to the service, equal to the withdrawal from duty of one-fourth of a company daily. Would adopt very much the same system as that which prevails in Paris, with certain modifications. If there were two or three examinations a year rigidly carried out, and if the women who were found to be in a diseased state were taken and confined in the lock hospitals, the very fact that that they were liable to such inspection would of itself act as a preventative, and it would be a beneficial system in time. Syphilis is decidedly not as prevalent among the native troops as among the Europeans, because the native soldier is always married, or with very few exceptions.

MARRIAGE OF SOLDIERS. 2407 to 2416.

It would be desirable to encourage marriage among the British soldiers in India as regards their state of health, unquestionably, but there are other reasons which might perhaps render it not desirable. He is assisted in maintaining a wife and children by Government ; he could not support his wife and children merely on his own pay. If you encourage marriage to a very great extent, of course there must be assistance given to a large amount by the Government, and then it becomes a financial question of considerable importance. Marches in the Madras army are much more accompanied by outbreaks of cholera than marches in the other presidencies, because of the extreme length of the march. When the soldiers become fatigued, they are in that state more prone to fall ready victims to any epidemic ; also they carry their families with them, and in marching their means are hardly sufficient to enable them to pay for the carts in which their families are carried, and to feed both themselves and their families. Both sepoys and followers are thus half starved. The more followers you have in camp the greater is the risk of disease, particularly cholera.

Dr. JOHN M. M^cCOSH, Staff Surgeon, Bengal Army, Retired.

Dr. J. M. M^c Cosh.

SANITARY CONDITION OF STATIONS. 2421 to 2477.

Has served for about 25 years with Company's European troops in Bengal. Served throughout the Cole campaign, the Mahratta, the Punjab, and the Burmese wars, has been stationed at Rangoon and Prome, and visited almost all the other stations in Burmah on various expeditions during the late war. Prome is particularly unhealthy. It is completely shut out from the prevailing current of wind by a range of hills. It is also completely inundated to a very large extent. There are few parts not raised by artificial means, above the water during the rainy season for three or four months ; during that time men go about only on the artificial embankments and by boats. The station at Namean was selected on a beautiful slope, well raised above all inundation ; but it was in a forest. The trees were obliged to be cut down. It was taken possession of almost immediately, and it turned out to be very unhealthy. Nevertheless, Namean with proper clearance and drainage might be made as healthy as any station in the interior of Burmah. Prome was selected without any reference to sanitary considerations, but merely because it was an important town in the Burmese empire. It can never be made a healthy station for occupation by European troops. There is a range of hills running parallel to the coast not more than 50 or 60 miles from Prome, between Prome and the Arracan coast, about 2,000 feet in elevation. Rangoon is situated upon red primitive soil, and is liable to be inundated all round ; but the cantonments stand upon the primitive clay soil well raised. Rangoon is a very healthy place for the tropics. It is very much better than Calcutta. Pegu generally is more healthy than Bengal proper. Barracks for the European troops in Rangoon

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were all built of teak; stout timbers were sunk three or four feet into the ground, six or eight feet apart, as a foundation; the floors were planked and raised about three feet above the ground, and the barracks were mounted by a ladder. The walls were built with planks overlapping one another, and the roofs were made of thatch. Those barracks were very healthy considering all things. Since then there has been a good deal done in the way of improving the internal arrangements. The country round Rangoon is inundated, and there is no means of protecting it from the inundation. In September, when the river has fallen down low, and the great mass of the water has run out, there are thousands of miles of stagnant water all over the country, which are allowed to dry by evaporation; and they might all be drained after the rains.

HILL STATIONS. 2488 to 2566.

Has been cantoned for three years in the Himalaya mountains, at Almorah, 5,600 feet above the sea. There are means of cantoning any amount of European troops in those hills. Between Almorah and Lohooghaut 10,000 troops might be cantoned. Very perfect sites for cantonments could be found on the Deo-Dhoora range, 6,000 to 7,000 feet above the sea. A very good cantonment could be made at Lohooghaut for a European regiment; its elevation is 5,500 feet. This is the best elevation; to go higher is to get more fog and more rain, and a rigorous winter. Most of the hill stations are 1,000 to 1,500 feet too high. Would prefer the northern slope of the range to the summit. At a point 1,500 feet below the level of the ridge the mist and rain are but little felt, owing to the clouds being blown over it, a fact well established. Troops might have a camp for exercise in the Terrai during the cold weather, and they might be then employed in clearing the jungle. From 15th November to 15th February the Terrai is as healthy as Upper India. The roads are not very good, but still they are passable for troops from Lohooghaut; two days march would bring them into the plains, perhaps one forced march would. The country through which the troops would have to pass, is very unhealthy during the rainy season; in fact it is not passable for troops at that season. But the Terrai might be cleared so as to admit of troops passing at all seasons of the year. If a railway were driven up to the foot of the hills from Kanouge, the troops might leave the cantonment in the morning, be on the railway by the evening, and by the next morning be on the banks of the Ganges. If a large proportion of the European troops were quartered on the Himalayas, it would be very desirable, and it would be very conducive to the effective strength of regiments. Troops that had been stationed at Kussowlie, Dugshai, and Subathoo, were marched down to Delhi at the beginning of the mutiny, went through the whole of their exposure well, and were perhaps more healthy than if they had been in a quiet cantonment. A man leaving a temperate climate could endure the heat of the Indian plains better. New-comers do not feel the heat so much as old Indians do. Continued exposure to heat produces more debility, which increases with the time of exposure. The advantages of residing in hill stations are, the cool temperature, which is the principal thing; the absence of malaria, and the absence of epidemics, cholera, small-pox, and fevers, generally speaking. The weak point of hill stations, is in all, without exception, a disposition to diarrhœa, which, in extreme cases, runs into dysentery. It is not of a serious nature, if a man is otherwise healthy. But among sickly men it may become fatal. It is difficult to define the causes of hill diarrhœa; one cause is, that the perspiration is immensely reduced after leaving the plains, and going up to the hills; consequently the effusion by the skin is perhaps made up for by an

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extra secretion from the bowels. Generally speaking, the mountain stations are more valuable for the prevention of disease, than for its cure; but with regard to the majority of diseases the troops suffer from, they benefit largely by the hills. Natives in hill stations are generally healthy, but they have also their epidemics, and strange epidemics too. In Kumaon there is a disease that bears a close resemblance to the plague, and now and then this breaks out amongst the natives, at elevations of 7,000, 8,000, and 9,000 feet, and the mortality is awful. It is called mahamurry, or the great murrain. Goitre is very common on limestone formations, and sometimes small-pox, but cholera is very seldom known in the hills. Has never known an instance of mahamurry in Europeans. The natives are a very dirty race, and have the cattle under the same roof with themselves; their houses are generally built upon a hill, and the lower apartment is used for the cattle, they themselves living above it, and all the dung, and all the offal, and offensive matter of the cow-shed is immediately below them. The clothing of the natives is very seldom washed. A great deal has been done by the civil authorities to introduce more cleanly habits. In Kumaon there is a sufficient supply of water, but in some of the stations there is not; for instance, at Landour they are obliged to bring the water up from a descent perhaps of 1,000 or 1,500 feet. The only supply of water is got from a spring, perhaps 500 feet below the level of Mussourie. There is a great difference in the height of springs in different parts of the year. Upon any range in the Himalayas, if there is no water upon the summit of a range, there will be water at 1,000 or 1,200 feet lower down, and this site may be preferable to a station on a ridge.

COMPARATIVE HEALTH OF DIFFERENT ARMS. 2567 to 2578.

Has observed a very great difference in the healthiness of the British troops, infantry, cavalry and artillery. The European artillery decidedly were the most healthy. They are a superior class of men altogether to any other troops in India. They are men of more intellect, and who take more care of themselves. Most of them are well educated, and students of law, physic, and divinity are not unusual in a battalion or troop of artillery. At some stations they take it upon themselves to go out at all times of the day, although there may be standing orders that they are to remain in barracks, but European troops generally will straggle out. Generally they are more temperate. They have more exercise than line troops. No doubt, exercise must be very conducive to health. They work more with their arms. If some simple instructions for preserving health were drawn up and handed to every recruit, it might do good.

RATIONS. 2582 to 2595.

With regard to diet, every care is taken as to the rations of the soldier. Each mess has its own cook or cooks, and generally speaking, their rations are cooked according to their own taste. Spirit is not a part of the soldier's ration, it is an entirely optional thing. Ale might be more generally introduced in European regiments than it is. Good Bass and Allsop's ale is served out by the commissariat to the soldiers at three annas a quart. This is, perhaps, half, or one-third its cost price, and the Government bear the remainder. Very good ale is brewed at Simla, Kussowlie, and Mussourie by European brewers, and on a very considerable scale, and sold at three or four annas a quart. Hill stations could be made to supply the whole army with good wholesome ale.

SERVICE IN INDIA. 2607 to 2620.

In order to improve the health of the soldier, he ought to have some more inducement to live, and to have the means of living when he is discharged. What is wanted more than any other object is, *the means of living when discharged.* The greatest evil the soldier has to suffer from, and the greatest difficulty a surgeon has to encounter is ennui,

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which is induced by perfect idleness. Would give him a higher rate of pension, and give him a prospect of being able to live upon it. A soldier, after having served 10, 15, or 20 years in India is a broken down man; he is incapacitated for almost all other service when he is discharged, and he has little therefore to look to, but his pittance of a pension. A great many pensioners remain in India. There are 2,000 or 3,000 in India now. More might be done for the soldier in the way of occupying his time. They might be well occupied in manual labour on the public works, if they had a certain amount of pay for what they did.

VENTILATION OF BARRACKS. 2643.

With regard to the ventilation of the barracks, that is a matter which is not sufficiently attended to, for soldiers will stop the ventilation, and will obstruct it if they can, especially in the cold weather. In the hot weather they will not remain in the barracks, but sleep in the verandahs, or they sleep outside altogether under the naked sky; that is during the hot wind.

Dr. R. A. Smith, F.R.S.

Dr. R. ANGUS SMITH, F.R.S., Professional Chemist.

DISINFECTANTS. 2689 to 2741.

Suggests the use of disinfectants, carbolic acid and Macdougal's powder, for malarious soil, to prevent the disengagement of malaria, and also for sewage and other offensive matters to prevent nuisance. Proposes to apply disinfecting fluids to large surfaces by water carts.

WATER SUPPLY. 2742 to 2766.

Has paid a great deal of attention to the question of the water supply of towns. In examining sources the present practice is first to examine the physical appearance of the water, and to test it; the next is to examine the hardness of it according to Clark's test. The hardness means simply the amount of salts of magnesia and of lime; it is then analysed. Believes that a preliminary inquiry is always made; but the engineer decides upon the spot from which he shall take his water, and whenever he has made his decision he sends for a chemist to make an analysis. The water is, therefore, good or bad very much by accident. To prevent this uncertainty the chemist should be consulted by the engineer as to what will be the best spot to obtain the water from. It would be very far from safe to select a water source or dig a well in such a soil as that of India for the purpose of supplying water to stations without a previous chemical examination being made unless certain conditions were observed. If you dig below the vegetable soil and encircle the place by tubbing or by bricks, and then dig under the sandy soil or the inorganic soil, all the water that was taken from a depth below would necessarily pass through the inorganic soil, and being thereby filtered you would generally get more or less of it always pure; but if this precaution is not taken, the water will necessarily contain a good deal of organic matter, and will, upon standing, putrefy. It is always better to have an analysis, as it makes you more certain; and there may be inorganic poisons which will not be filtered out by the subsoil; but there are cases in which it is difficult to obtain an analysis. A great deal of life might be saved by having water sources analyzed. A chemist to whom questions on various subjects might be put might probably turn out to be one of the most valuable officials in the Presidency. As a nation we are extremely unwilling to seek the aid of science, we wait until it shames us into listening. The smallest quantity of organic matter that is likely to be injurious to health in water entirely depends upon the quality of the organic matter. If it is water from a peaty district three grains are scarcely to be considered bad, in a sanitary point of view; if from putrefying matter half a grain might be in-

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tolerable. Water containing from five to six or ten grains of organic matter per gallon could not be drunk, and could not be used at all. No Indian chemist so far as he knows has published any analysis of the water contained in the wells in the alluvial plains of India. In the alluvial plains of India, and along the course of rivers, water taken from the loam without going deeper, will contain a portion of all that is there, a good deal of organic matter, five or six grains per gallon. Beyond a doubt such water would cause disease, dysentery. Has been told of an instance in which water long stagnant caused ague when drunk. Such water might be very easily purified, filters of charcoal might be established with the greatest completeness and at a very cheap rate. To make a filter, perhaps the best way of all is to make a mixture of charcoal and sand, or at least a layer of charcoal and a layer of sand, for sand evidently gives the final purification to the water, and makes it very pleasant to the palate, that being the most usual natural substance for purifying water. Animal charcoal or burnt bones ground are more efficacious than wood charcoal.

Impurities of Air. 2769 to 2772.

With regard to the existence of organic matter in the air, has taken deposits on walls and deposits on glass which are formed by the moisture floating about in crowded rooms, and has found that these, after a while, became putrid ; that is to say, if they are examined by the microscope you find confervæ growing thickly, and minute animalcules growing in them, and if you examine them chemically you will find that they contain the same elements that are found in the flesh ; these are the substances which render crowded rooms unwholesome ; it is not so much the carbonic acid of which people speak, but it is these organic matters which are developed along with the carbonic acid, the carbonic acid itself not having the same effect, but acting in a very different way, and to a much smaller extent. Putrefaction being more rapid in a hot climate, these organic matters being in the atmosphere would be more likely to be injurious in crowded barracks in India than in England.

J. Jeffreys, Esq., F.R.S.

Julius Jeffreys, Esq., F.R.S., Staff Surgeon, Bengal Army, Retired.

Sanitary Condition of Stations. 2773 to 2796.

Has served in India for 12 years with Queen's troops and others, in the Bengal Presidency at Fort William, Kurnool, and Agra, at Cawnpore, Furruckabad, and Futtyghur. Kurnool was unhealthy from the canal being occasionally low and exposing extensive mud banks. Fort William is in a low situation, not lower than other parts of that part of Bengal ; it is a flat plain with water within a few feet of the surface. The barracks of the European soldiers were then faulty from being on the ground floor. Cawnpore was rendered artificially unhealthy by the high mud walls erected round almost every building in the cantonment, and especially from the large ravines about the bazaars ; some of the barracks are very ill placed ; the barracks of the European infantry more particularly were ill placed, in a part of the cantonments where the circulation of the air was obstructed ; they were also not far from the ravines referred to, which were at times very filthy places from being visited by the natives ; they had no places of accommodation, and they were visited every day by the natives. That was a mischief easily remedied. With regard to the drainage in stations care was not taken to remove offensive matter to a distance. The bazaar pigs, which were chiefly eaten by the European soldiers, were the chief scavengers. Malaria was to a certain extent induced by nuisances being left in the neighbourhood

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of the stations which might have been easily removed. Doubts whether once in 24 hours everything of an offensive nature was removed. The up-country stations were almost entirely supplied with wells, and the water was very good in general. At times it ought to be filtered. In the lower country water is chiefly supplied by tanks or from a river. In that case it is often impure.

BARRACK CONSTRUCTION. 2803 to 2819.

Does not recollect anywhere in India having seen European troops quartered on a first or upper floor, and there was evidence quite conclusive that much disease did arise from their being housed on the ground level. It is well known in all tropical countries, that the density of malaria is in some very high ratio inversely proportionate to the distance from the surface of the ground. In India exhalations are rendered visible by smoke or fog in cool mornings. You will see vapour and smoke overlying the whole face of the country at the level of a few feet from the ground, with the air, immediately above a certain level, transparent. That exhibits to a certain extent the state of stagnation of the lower atmosphere, and the exhalations from the surface to be very much more dense there than at a certain height above it. The housing of men on a first floor would involve very little extra cost, as the ground floor would be available for other purposes. Would place the men in the first floor of a barrack universally at least 15 feet above the ground, especially in Bengal, and indeed everywhere in the plains of India. As things are now it has very often been found necessary to build a high mud wall round the compound, which not only obstructs the air, but is sadly dispiriting to the men ; whereas if they were placed on a first floor, and the sentinels were up at the same level, it might be so contrived that a man could not get down very easily 15 or 20 feet ; he would be placed above the level of the wall, and he would have the verandahs on the shady side, where, in the rainy season, when the heat is not great, he might recreate himself, and walk and stroll, or sit down to read and enjoy himself ; it would be in every way productive of benefit, and perhaps most of all at night ; if he is sleepy, he might lie then in a current of air, which he will now always do, but it would be of a very different character from that below in which he does lie now, only two or three feet from the ground. About Calcutta no one who can avoid it sleeps at a lower level than the first floor. All who can, elect to dwell altogether on the first and upper floors of their houses. Proposes a plan for constructing temporary barracks of uprights, scantling and thin sheet iron. Proposes a new method of pitching tents, whereby instead of pitching tents separately their flies or roofs should be looped together,—say any number from two up to twenty tents or more in one block ; four or five tents in length, and three or four in breadth. All walls would be dispensed with, excepting the outer walls of the tents surrounding the block. Thus a square block of twenty tents, each of thirty feet by twenty, would form one large room about 120 feet square. Proposes the adoption of metallized cloth surfaces for tents to throw off part of the sun heat.

VENTILATION. 2840.

Currents of air falling on the body should be avoided in ventilating arrangements. A native watching a garden of melons at night, invariably places a mat to windward of his low bed, which is generally of a certain height, to shield him from the wind, and to cut off the immediate current of wind from his body ; that is a matter really of prime importance, for it will often just make the difference whether a man escapes or not an attack of rheumatism or of intermittent fever.

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Dress. 2841 to 2843.

Proposes metallic paper as a cover for head dresses in India, to protect the head. During the mutiny, a detachment is stated to have become unaccountably panic-struck, though drawn from a distinguished regiment and the naval brigade; and out of so small a body no less than 107 are said to have died in the day or two's exposure from solar apoplexy, 18 of whom had been wounded. A small square of tin-bronze cloth or even tin-bronze paper arched over their hats might, though it is but an imperfect protection without other provisions, have probably saved several of these lives, by sufficing to keep the solar action in such cases within the point of destruction.

Cooling Air in Barracks. 2853.

Proposes to cool the air in barracks in hot weather, and to warm the air in cold weather by passing it through a series of underground wells or tunnels before being allowed to enter the rooms. A system of 100 or 120 such wells would effectually cool for seven months or more each year air enough freely to ventilate a barrack 300 feet long, 60 wide, and 20 high. These wells ought to be sunk to about a foot from the water level, which at Cawnpore and Futtehgurh is about 40 feet from the surface. At Meerut and Kurnool perhaps 20 feet. In the Agra district from 60 to 80. Air to be forced through the wells by windsails, fanners, or pumps.

Ventilating Helmet. 2861 to 2874.

Proposes a ventilating helmet consisting of two layers, leaving a space between them, through which a current of air can pass to carry off the absorbed heat, and also having an inner lining capable of being fitted to the head. When this is done, a second air space for ventilation is left between the lining and the inner layer of the helmet. Proposes also a helmet with a similar inner lining and a single outer shell covered with reflecting material to throw off the sun's rays. Head dresses of this description would diminish attacks of solar apoplexy.

Clothing. 2886.

While entirely assenting to the opinion that the head is the portion of the body which most needs protection, would on no account omit this opportunity of stating that it is absolutely necessary, for anything approaching to that immunity which might be conferred upon troops under sun-blaze in India, that the trunk of the body, more especially the spine, should be duly protected. Flannel, of a soft and open texture, next the skin, from head to foot, should be worn by all. Not only will it guard against sudden chills—the cause of so much illness, but it will husband the perspiration—a point of great importance to all, to those especially who have a tendency to dryness of the skin in an arid atmosphere. Has repeatedly ascertained the temperature of the skin, in hot and dry weather, to be much lower under flannel, with a cotton dress above it, than under the cotton alone. The flannel moderating the evaporation keeps it moist and cool, the cotton permits a rapid and chilling evaporation, which overtaking the power of supply, is soon followed by chronic dryness and heat of skin in a hot wind. The outer dress should be white cotton.

Hill Stations. 2887, 2888.

Considers that as large a proportion of European troops as possible, compatibly with military and financial reasons, ought to be quartered in the hills rather than in the plains. At the same time too great heights should be avoided for continuous residence, and it would be well to have stations at at least two different elevations, say 4,000 or 5,000 feet, and at 7,000 or 8,000 for invalids suffering from different forms and states of disease.

Means of Occupation. 2893 to 2901.

Strongly advocates employment for soldiers in India by giving them occupation in their familiar lines; some might be employed upon experimental farms and field-gardens, and manufacturers might be employed in their several arts by having workshops. There is no such thing as a firebrick in India; the natives have no idea of the proper art of

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smelting or founding, or of firing porcelain or stone pottery, and they cannot forge iron beyond a certain thickness. They have no such thing as proper forge bellows, and foundries in a proper sense they have none; they cannot cast iron and they never attempt it; and even the mode of casting brass is very operose, and the reason is that they have no firebrick, no furnaces that will stand great heats at all. It is not that the country does not produce the material; has made in India firebricks of various kinds, one kind of which when tested with the best Stourbridge bricks surpassed them. All the arts of life, even the mechanical, are either directly or indirectly dependent upon the *firebrick* for their perfection. To diffuse the use of an indestructible firebrick in India would confer upon her a very great benefit, one surpassing the discovery of a gold mine. In pottery the natives have no better a body than can be produced by a common red heat—a porous substance little better than a tile, though often hidden under a crazy glaze. Their only passably good glass vessels are made from broken English phials and table glass. No ploughs, properly so called, exist; the land has therefore to be turned over with the pitiful substitute from 5 to 12 and even 15 times. How important to the Government would be any improvements in agriculture introduced by experimental farms, managed cheaply by the soldiery, may be judged from the fact submitted to the Government of India, as the result of these inquiries, that the cost of irrigation alone exceeds in the Western provinces the whole land revenue. Laid before Lord William Bentinck, in Calcutta in 1833, a proposal that schools of useful art, managed by soldiers, each in the line he had been practised in, in England, should be established at all European stations—that each such soldier should have a number of native boys of the respective trades apprenticed to him, who when their time was completed should go forth well equipped to carry a better art into the towns and villages of the country. His lordship viewed the plan very favourably. Sir Hugh Rose has adopted the view, and has, it is said, decided on a commencement of affording to the troops such a recreative employment of their time. Soldiers might be employed in the ceramic arts and glass in the cold season, as well as in trial farms, especially with a view to the introduction of some light plough for India, and of improved apparatus for well irrigation; also in many chemical arts, especially tanning and dyeing. Indian leather is most faultily made. The hide is rotted by the process; and though India is the land of indigo, the natives cannot make a proper indigo dyer's vat. It would be beneficial to the health of the soldier, and conducive to his happiness, if he were allowed to do for himself whatever he could do, without injury to his health and discipline.

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Sir JOHN LAWRENCE, Bart., G.C.B., Member of the Council of India.

BARRACK CONSTRUCTION. 2902 to 2920.

Has seen a good deal of European soldiers in India. The new accommodation afforded by the barracks in the Bengal Presidency, which have been erected within the last fifteen years, was very good indeed; the old barrack accommodation was not very good. The barracks are better with respect to ventilation; there is more accommodation provided, more cubical space allowed for each soldier; they have been more careful in selecting the sites, and the buildings themselves are better constructed, in fact, in every respect there has been great improvement; all the accessories of the barracks are much better, the cook-houses and out-houses, and everything connected with them. Should say that they were twice as good as they were formerly. There is no room for complaint as to the nature of the accommodation

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afforded in the Punjab. The only defect he ever saw was this, that they build a barrack too large; they build a barrack for a whole company, say of 100 men, and it would be better if they had a barrack constructed for half a company or a quarter of a company. The advantages of small detached buildings, as compared with larger barracks, are, that if anything like an epidemic broke out among the men, it is much more manageable; for the men, both morally and socially, it is better to be together in moderate numbers than in greater numbers; if there are half a dozen troublesome men among them, they will disturb the whole of the men. They built some of the barracks in the hills of two stories, one company being above, and one below; and the noise of those who were above, if the others were unwell, would be very great, and the men say that they were not nearly so nice. At Subathoo the new barracks were very fine, and yet the men preferred the old ones, because they were more snug and less noisy than the new. The officers said that it was better to have them in large barracks, because the sergeants could look after them better, but barracks of a limited size are better for the men. The barracks which Sir Charles Napier advocated at Sealkote were unreasonably large; the walls on each side were 25 feet high; and, in fact, they were so large and airy, that they were cold and uncomfortable in the winter. The idea was, that it was better to build a barrack of a very large height, so as to give great vertical space, and so as to make overcrowding impossible; but there is no danger of overcrowding, except upon an extraordinary crisis. It would be better to have small barracks for few men than large barracks for a number. In Bengal and in all the damp parts of India it is of great importance that barracks should be raised, but in the Upper Provinces does not think the same rule holds good. Perhaps the best plan would be to occupy the lower rooms in the day time, and to make them serve for libraries, and workshops, and dining-rooms, and then have the upper rooms to sleep in at night, for in the day time the upper rooms are much hotter than the lower rooms. A lath and plaster ceiling would have all the advantages of a double roof without the expense of it.

DRAINAGE. 2922, 2923.

Drainage has not been cared for so much as it ought to have been; it has of course been improved considerably of late years. A great deal of attention has been paid to latrines. The drainage at Peshawur was not good; it required to be carried out to a very large extent.

SELECTION OF SITES. 2924.

Some sites of cantonments have been extremely well selected, and some very badly selected; there is great difference in them.

VENTILATION. 2932.

It would be better to have all the doors to open, for when rain falls in the hot season, it is a great thing to be able to throw open all the doors, and give a regular sweep of the wind from one end to the other.

PLAN OF CANTONMENTS. 2932 to 2936.

One advantage in double stories is, that you can place your troops on a smaller amount of ground, which in particular parts of India is of great consequence. The front of the barracks which the 81st Regiment occupied at Lahore was not less than a mile long; the canteen and other conveniences were at one end, and the men had to go from the extreme right flank to the extreme left flank, a distance of about a mile. If there was a disturbance in the interior, and it became necessary to march away 500 or 600 men, the extent of ground and number of buildings which the remainder have to defend becomes a serious evil. The plan in a cantonment should be this: Concentrate the buildings as much as can be done consistently with sanitary precautions. At Rawul Pindi the barracks are placed in a double row, and they occupy a very moderate space of ground, and are very easily defensible,

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and yet there is plenty of air. A portion of the cantonment should be partially fortified. We do not have thatched roofs when we can avoid them. Sometimes they are run up at first in the temporary buildings. Umballa was full of thatched roofs, and the way in which these were burnt in 1857 was one of the signs that the mutiny was coming on. It was generally at the end of the cold season and after a campaign that a new cantonment was decided on, and the paramount consideration was to cover the troops, and these thatched roofs were temporary arrangements, but in the course of time that which had been a temporary arrangement became practically permanent; those in authority were so long a time in making arrangements for the permanent buildings that these at length had a permanent character.

WORKSHOPS. 2937, 2938.

Men hardly work at all in workshops in India; the object in providing workshops is to try to induce them gradually to do it, but the men do not like working in India. It is difficult to sell what they produce; there is not a ready market for it; the natives can undersell them in almost everything. One of the inducements to employ themselves would be to get them a sale for their produce. The men do not read much as a rule; there is not one man in a hundred who cares about reading.

CAUSES OF MORTALITY. 2939 to 2941.

The mortality among European troops is very great; it varies in different regiments and in different localities, but everywhere it is very great; it could be reduced considerably; want of occupation, *ennui*, and the habits of their lives, want of care for themselves, and the way in which they indulge themselves, particularly when they first go out, are very injurious to the soldiers. The habits of life of officers and men are very inimical to health in India; that kind of life, which in Europe or in a very cold climate perhaps would not hurt them, except by slow degrees, in India is extremely pernicious, and soon produces bad health and increased mortality.

DIET. 2942 to 2948.

They eat too much animal food and drink too much for the climate of India. The natives who are accustomed to the climate of the country eat very little animal food, particularly in hot weather, and they do not go out in the sun more than they can help. The men eat too much, in the hot weather in particular. Medical men say they eat meat twice or three times a day all the year round; does not believe that any officer does, and if he does, he gets sick, too. They like meat, and meat is bad for them in hot weather; if they have any money, they buy bacon and pork, which is very filthy in India, being badly fed. Government might try to induce the men, by varying the ration with reference to hot or cold weather, to take more to vegetable diet. Changes in the diet might be made according to the several seasons very much to the men's advantage. If you could get the men to take fruit and vegetables in the hot and rainy season, and to diminish the amount of the animal food, it would be advantageous. You must try to carry them with you.

OCCUPATIONS. 2955, 2956.

As regards occupation, the men would take more pride, and the officers would interest themselves more in anything connected with the regiment, such as making their own clothes, and their own shoes, iron work, and all those kind of things they might do. The object should be to make the regiment self-supporting as much as possible, even if it cost a little more. It would be a losing business in point of money, but the men would be more healthy and more happy; for the men are not happy; they are restless, and they want to be at something else, or to get away.

PENSION. 2958 to 2961.

An increased pension after a certain period of service would lead to many soldiers feeling more comfortable in India. The more induce-

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ments to good conduct you hold out to them, the more likely you are to induce them to take care of themselves, and behave well. Very few men ever look forward for half a dozen years; they are reckless and careless, and doubtless there is a great deal in the system to make them so. They like India better than England; and yet they are not happy there.

HILL STATIONS. 2963 to 3013.

With regard to Hill Stations there is no doubt whatever that the men would be much healthier in the hills than in the plains, but at the same time there are constitutions among them which do not benefit by the hills, or but very little; there would, however, be great difficulty in putting a large number of troops in the hills, because for financial reasons you must reduce your European force in India to as low a scale as possible, and if you do so, then you must put the bulk of the troops in the great strategical positions. One regiment would enable you to hold and keep in order a province which ten regiments would have a difficulty in recovering, if lost; Delhi and Cawnpore were lost in this way. You should hold your cantonments in strength sufficient to meet all comers and to go out and take the field when it is necessary to do so. In short, in India your arrangements should be such as to overawe and control the country. We should never forget for a day that we are few, at a long distance from our resources, with many who may rise up against us at a few hours' notice. When the mutiny took place in India, the British regiments were hurried down from the hills, and although there were only 40 miles between Umballa, Kussowlie, and Subathoo the man came down in such a hurry, and had such a difficulty about carriage, that many men were left behind, and they had to send off camels and every kind of conveyance to bring them up. Now, suppose the people of the country had been hostile, every man of those who were left on the road would have been cut off and destroyed. The extension of railways would modify this opinion to a certain extent, but that would not enable you to keep the bulk of the European troops upon the hills and hold the plains with Native troops. All weakly and delicate men should be sent to the hills every year, and all the strong serviceable men kept down below. Supposing you have 1,000 men in a regiment you might have 200 or 300 in the hills, the remaining 700 would hold a station quite as well as the whole body, and do all that was required to be done. In some presidencies you could spare more than in others. The best arrangement would be to have all your regiments in the plains, but 200 or 300 of the men of every regiment in the hills. In Bengal you require very much fewer troops than in the upper part of the country; of those that you do require in Bengal a certain proportion might be in the hills; we formerly had very few troops in Bengal. With reference to the character of the people, 5,000 European troops in Bengal would go further than double that number in the upper provinces. As regards stations on the plains, a great deal depends upon the actual site on which you put troops; for instance, it may be necessary to put troops within a certain latitude and longitude, but within that latitude and longitude there is scope for selection; a few miles on this side or that would not signify. Officers may choose a spot which they consider very suitable for troops, and yet it may prove the very reverse. Oftentimes a good position apparently may possess objections which were not at first sight obvious, climate being purely a matter of locality.

WATER SUPPLY. 3013 to 3016.

In India one great point upon which good health depends is the water; our people very seldom look to the water, but the natives always look to the water in choosing a locality. The troops drink an immense quantity of water. It is important that the water should be

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of good quality; there is very great scope for improvement in the selection of sites in that way. Has seen positions which were considered unexceptionably good by Englishmen, but if you ask the natives about one of them, they would say that it was very bad on account of the bad quality of the water.

SELECTION OF STATIONS. 3020 to 3032.

A great deal depends upon the committee appointed to select the site of a cantonment. If you put carefully selected men upon it, a very intelligent officer and a medical man, who had turned their attention to the subject, and a civilian, who knows the country very well, they can communicate readily with the intelligent natives, and that committee would very likely make no mistake, but select the best site to be attained. But on the other hand, if you take a committee by roster, and put anybody upon it, the chances are that one man entirely guides the rest, and that man may be one who feels no real interest in the matter under consideration, when, of course the result will not be satisfactory. Take for instance the cantonment of Noushera; they put the cantonment there on the banks of the Cabul river, and it was well known that 20 years before that very site had been submerged, and several hundred people had been destroyed, but in spite of that they put the cantonment there, and when the river rose about two years ago the water was six feet high in the barracks, and all that might have been avoided if a carefully selected committee had been appointed. They are now going to put the cavalry there. Where a place was thoroughly proved to be unhealthy, would give it up at any sacrifice, but would have a thorough scrutiny beforehand before sacrificing the place, after spending a great deal of money. Planting trees upon a road near to a cantonment, so long as they are mere trees so that you can cut off the lower branches, do no harm; it is the underwood that does the harm. We were very inconsistent in some of the cantonments; for we cleared away all the gardens of the natives and entailed a great loss upon them, on the plea of sanitary arrangements, but at the very same time we left gardens to grow up in the cantonments themselves, and a great deal of jungle gradually grew up; jungle gives facilities for filth to accumulate, and stops the circulation of the air. A place without trees has a wretched and miserable appearance, and has an effect upon men's minds; every enjoyment which you can give to the eye, consistently with health, is beneficial.

INFLUENCE OF IMPROVED HABITS. 3034, 3035.

Habits have much to do with mortality at all stations whether healthy or unhealthy. Even at unhealthy stations civilians and merchants, clerks, and ladies, meaning the English part of the population, do not suffer in anything like the proportion that the soldiers do; therefore, the natural inference from that is, that there is something in the habits of the soldiers which renders them peculiarly liable to be influenced by the climate. An improvement in the habits of the soldier would be a great element in the success of sanitary measures. Saw the cholera raging at Murree, in the hills, 7,000 feet above the sea, in a magnificent climate, a beautiful site, and fine barracks, and there was nobody else sick but the soldiers; none of the officers had the cholera; none but the men had it. There is a good deal of cholera in the hills. In Cashmere, there is a very great deal of cholera; and all through the hills, from Cashmere to Kussowlie cholera at times prevails, but it does not affect much those who are cleanly in their houses and abstemious in their habits.

MARRIED QUARTERS. 3037 to 3042.

As regards soldiers' families the plan now adopted for lodging them in the Bengal presidency is very good; they have a little row of cottages, about six or eight. The women ought to have separate hospitals where the arrangements have been completely carried out; there was always that provision made in a plan. A European matron

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should be appointed. The health of women and children in the Upper Provinces is immensely impaired by climate; the children die at a fearful rate.

LAWRENCE ASYLUMS. 3046 to 3050.

The children thrive in the hills; the mortality in the hills is less than in England. There is accommodation for 500 at the Lawrence Asylum at Sunnawur, and they are building a new one at Murree, out of private subscriptions made in England, and in Calcutta, and in Lahore, to my brother's memory. The subscriptions were put together to make a new Lawrence Asylum at Murree; they have got one at Aboo, and the children there all flourish. They are received at the age of about 4 or 5, and they keep them until the girls marry, or the boys can go out to do work for themselves. They look like English children. Went over the Sunnawur Asylum with one of the native chiefs, and asked him how he thought the children looked, and he said that they looked like lion's cubs. The children on the plains all look pale, pasty, and wasted, with no breadth and no depth in them, and they all wither and die.

EFFECT OF HILL CLIMATES ON HEALTH. 3051 to 3056.

The soldiers do not flourish so well in the hills as may be supposed; they do not like going out and knocking about; and there are great difficulties in the hills as to communication. The hills are all steep, and there is not much flat ground; the cantonments are built on very limited plateaus, where the fall is very steep, and very few roads, and if you go off a road you have to undergo intolerable fatigue; for if you go down to the bottom of the valley, it will take you all day to come up again. You find the men huddling over the fires in the hills, and not going out and ranging about as you would suppose they did; used to go and look at the men, and try to get them out, and found the convalescents lounging about the fireplace. In the South of India, where there is plenty of table land, you can take exercise without fatigue. By means of the children an English colony could be formed if you had the means of supporting them; but there is very little arable ground. Does not see how you could make the place self-supporting. In the Neilgherry hills there is an extent of table land, but in the Himalayan ranges there is very little indeed, and the chief ground that the people cultivate is in the valleys which are extremely unhealthy.

SOLDIERS' MARRIAGES. 3063 to 3070.

A great deal of the soldiers' unhealthiness arises from their being unmarried. An immense amount of the disease in a regiment arises from immoral causes, and the married men are more careful men, and more likely to be steady men. The women have a good deal of influence in keeping them straight. Where the men die in the service, or are killed in the service, something ought to be done to help their wives, so that a man going into the field would feel that something would be done for his family in case he died or was killed; but we do better for the native troops than we do for the English in this respect. Again, if the husband of a woman dies in the service, at the end of six months she must, according to the regulation, marry or do worse, and the consequence is, that she marries any fellow, and that causes a great deal of unhappiness, and that unhappiness leads to crime and to demoralization. The women ought to be taken care of. They would then bide their time, and marry when it suited them. You might give married men a sufficiency to enable them to support their wives. At present you just allow a certain number of men to marry in a regiment, and you demoralise the regiment very much; troops are sent on foreign service, and they are allowed to take with them only a certain number of women. Every married man who is beyond the number is obliged to leave his wife behind, and he begins by throwing his wife to the dogs, and, of course,

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that cannot make him a better man or a better soldier; you make him break the dearest and holiest tie in the world, and it makes him reckless and good for nothing. Would raise the pay of the soldiers and give them leave to marry, and would take care of the wives and children of the soldiers who went into the field. When a native regiment is going on service, the first thing that respectable natives do, is to go to the officer and make some arrangement by which their women are to be looked after, and taken care of, and we ought to do that; it is constantly the case in a regiment in the service that there are women going to the bad for want of a little care. In a cantonment would leave a picked officer to look after them, a married man who had a sympathy with the women, and that would have an immense effect. And then great care should be taken that remittances are scrupulously made. You might have some system by which the men bound themselves to remit. In the height of the mutiny officers of native regiments at Delhi used to write to him to look after the wives and children of the men who were in the Punjab, and supposing that he had neglected them, it might have just turned the scale against us. An officer of the guides wrote to say: "There are such and such women at Lahore "belonging to the Guide corps, several of their husbands, men of rank, "have been killed. Mind you look after those women carefully, and "do not let them be in distress." Did so just as if they had been some of our own people, and of course that went down to the corps, and the men all heard of it, and felt it very much. This you do with the foreigner and the stranger, why not do it with your own countrymen? If you trace back the history of a woman, who has perhaps become a nuisance in a regiment, you will often find that she was a decent body when she began her career and before misfortune overtook her; does think that the practice of abandoning their wives when a regiment is going on service is very bad indeed, and produces terrible results.

Col. E. H. Greathed, C.B.

Colonel Edward Harris Greathed, C.B.

Condition of Regiments. 3074 to 3083.

Has served in India 11 years; at Poona, Bombay, Kurrachee, at Hyderabad in Scinde, at Agra, and at Jullundur. Has also seen Cawnpore and Allahabad. The local European Infantry worked better in the sun than the Queen's regiments. The only reason given for this was that when recruited the men were rather older. It is not greater familiarity with the requirements of the climate that gives them that advantage; the men, as a rule, in India are very careful. The moral tone in India is far higher than it is in England. The men obey orders very strictly, of course, with a few exceptions; there are always 20 or 30 blackguards in every regiment. The higher tone among the men is easy to understand; there are no pothouses there; there may be a great deal of vice in the bazaars, but it is not society; not the society in which they live.

Barrack Construction. 3085 to 3095.

The new barracks in India are very good, the old ones are very bad as a general rule. At Poona they are building some excellent barracks; at Kurrachee they are also very good; at Hyderabad the barracks erected by Sir Charles Napier were excellent, but they had one fault, which was, that they were constructed almost entirely of brick, and the heat of the climate is so tremendous that the sulphurous fume of the bricks came out in such a way that the smell is like that of a brickfield; the brick flooring of the outer verandahs particularly is excessively hot. Flooring of rammed earth washed over with cowdung keeps away fleas and bugs better than anything else. At Deesa the barracks were bad.

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At Agra the new barracks were in course of building, apparently very good; at Jullundur they were well planned, but they were constructed of very bad materials indeed. The hospitals are universally spacious and airy; they are well ventilated by box ventilators in the roof. The doors are habitually open.

URINALS AND LATRINES. 3096 to 3100.

We never used urine tubs, but the smell from the urinaries in the rear of the barracks was a great objection. The latrines were very good, and very well managed, but the arrangements of the urinaries were very bad. They were nearer to the barrack; the smell was always perceptible in going through the barracks; there is never any time of the day or night that you do not smell them. The draining might be very much improved in that respect.

CLEANSING OF BARRACKS. 3101 to 3103.

There are certain periodical cleansings of walls and ceilings, but there is no difficulty in getting an order for cleansing from the general of division, in a case of emergency the executive engineer will execute anything. Every officer who has served in India must bear witness to the way in which the engineers assist one on all occasions.

DRAINAGE. 3105, 3106.

The stations are generally surface drained; when there is a heavy fall of rain it is very commonly not carried off as well as it might be. They complained of the dampness of the floors at Jullundur at one time, from the badness of the brick flooring which had given way very much, and had not been well executed, but not in any other station.

ABLUTION AND BATH ACCOMMODATION. 3107 to 3116.

In almost every station there are plunge baths, which are provided for the men and the non-commissioned officers, generally two to each barrack, and where gardens are provided for the troops the waste water runs off to supply the gardens. The ablution rooms in barracks are generally imperfect, and the provision for ablution in the hospitals is very imperfect indeed for the comfort of the inmates. The baths are always full; there is always a surface water running through them. It would be a good thing if a general order was issued in India that the men should have bathing parades; there is no general order to enforce it at present. Bathing should be done under a subaltern, a company at a time. The means of washing the bed and body linen are sufficient. they have four changes of raiment a week. The only way in which the men in hospital could get at the basins was by sitting on the floors; there are no warm baths attached to the hospitals. Would suggest a bath room in hospitals.

SURFACE CLEANSING. 3120, 3121.

The surface cleansing of a station is under the brigadier commanding, and he is responsible for the cleanliness of the station. The different officers act under him. The refuse is carried out, and generally buried; but in some places it is burned to great advantage in pipes.

BAZAARS. 3126 to 3132.

There are regulations in every presidency of the most minute description with regard to the bazaars and with regard to the cantonments. The bazaars themselves are kept very clean; the drainage is better in some than in others; and where they had introduced what they call the saucer drain, a flat drain, all the bazaars were very clean; in others, where they had the deep drain, they were not so effectual, but they were kept very clean as far as sweeping went. The superintendent of the bazaar is responsible for its state. Cattle are slaughtered at a sufficient distance from the barracks, and the offal is eaten up by innumerable kites and vultures. The police regulations are very good indeed.

WATER SUPPLY. 3133, 3134.

At Poona the water was abundant and good; at Bombay, when I served there, the water was very short, but that is remedied now by the Vehar waterworks. At Kurrachee and at Hyderabad the water is procured from the percolations of the Indus; it is very dirty, but it is very good water. The common way to purify it is to let it filter

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through three large jars with charcoal and sand, and it comes out very clear, or a little alum is used.

RATIONS. 3139 to 3155.

With reference to the rations, it is entirely the fault of the officer commanding the regiment if the men are not perfectly well fed. Lord Dalhousie earned the gratitude of every regimental officer and soldier in India for this. The ration includes about eight ounces of vegetables; of course that depends upon the supply. In Scinde has been almost entirely without vegetables of any sort for the men. They get oranges in abundance, and also plenty of mangoes in the season, and custard apples. The Government gives a very liberal supply of cooking utensils, which are tinned once a month under the supervision of the quartermaster of the regiment; these are carried on the march in carriages supplied by the commissariat, and the cooking is performed entirely by native cooks, who are very good servants indeed. They have the rations cooked just as they like, and they are fond of having pillau or soup; or they have the meat simply broiled; they live better than they do at home; there is no comparison. They have three meals; breakfast at 8 o'clock, consisting of bread and coffee or tea; dinner at one o'clock, supper at half-past four or half-past five, according to the season of the year. It requires a little care to prevent them from exchanging their rations for bazaar bacon; the flesh of the unclean animal, bad and poisonous. The married soldiers were allowed to draw the ration money instead of the rations, and they managed better with the money than they did with the rations.

INTEMPERANCE. 3158 to 3198.

There is no spirit ration properly so called. On the march a dram is issued once or twice a day. The spirit is sold in the canteens under very strict regulations. Intemperance has not been common in India. In his own regiment, upwards of 1,000 strong, a fortnight has elapsed without a single man being confined for drunkenness. The police of a regiment is remarkably good in India. The soldier must drink his spirits at the bar of the canteen. The shops established by the civil authorities upon the outskirts of a cantonment are so positively forbidden to sell to him that they can only venture to do so in a quiet underhand way, but if they do so they are sooner or later hunted out. The more you can keep the abkarrie within due regulations the better. Malt liquor is procurable at all the stations. The consumption of malt liquor is encouraged to the greatest extent in stations. But if you do away with spirits, how will you provide for the canteen fund? Should wish beyond everything to see the practice of supplying spirits in canteens abolished. Would prevent the soldier from getting spirits at all. Would substitute beer for spirits, but there would be great difficulty about it. The canteen fund arises from the enhanced price at which the spirits are sold,—8 annas or 1*s.* is imposed upon every gallon of spirits, and that in a very short time creates a fund which supplies the wants of the soldier without any expense to himself; for instance, the canteen fund, under the regulations of the Government, pays for the cap covers of the men, which are very necessary, and a constant expense; it also pays for all his amusements,—the fives court and the theatre; the skittle ground and the gardens, and in fact any reasonable request which the commanding officer makes is always granted. The large amount of the canteen fund implies a large consumption of spirits, but still a very fair fund can be kept up, and yet the men will be very moderate in drinking spirits. It accumulates in a wonderful way; in fact the great difficulty in a regiment was to keep it down. After 3,000 rupees are accumulated the Government may lay its hands on the fund, and it is the object of the officer commanding the regiment to spend it as quickly as he can. Cannot defend it. Let

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the Government give the money and the thing might be done ; it is a question of money. There is a great deal of beer consumed by the soldiers. Of excellent quality. It is always examined, and rejected when it is bad. The price of beer in India is 6*d.* a quart.

MEANS OF INSTRUCTION AND RECREATION. 3203 to 3234.

In the hottest station, Deesa, where we were for three years, the mortality in the regiment was extremely small, and the general health of the men was excessively good. They were able to take the most active exercise there without suffering from the heat. We allowed them to go out shooting as much as they liked all over the country, and a man would go and walk 14 miles on foot from the barrack, and be back at night ; their health and spirits were excellent, and there never was a single case of a difference between the soldiers and the natives in the whole of the three years during which time we gave them unbounded liberty ; meaning, of course, to the good men. The great game for soldiers in India is what they call long bullets. They also play at quoits, cricket, and fives ; those are the usual games ; but the best of all recreations was this ; we encouraged them to go out shooting when it could be done with safety, and we found the best possible effects from that. Never saw the men much hurt by the sun. They liked the amusement, and the liberty was never in any single instance abused ; it was quite a point of honour with the men to behave well. There is a regimental library, which is kept up principally by the Government ; they provide the books entirely. A very small subscription is taken from the men. The schools are also kept up by the Government partly, and partly by small subscriptions from the soldiers. There are normal schoolmasters employed. The success of the school depends extremely upon the schoolmaster ; also upon the encouragement given by the commanding officer ; in fact, the commanding officer of the regiment and the chaplain carry on the management of the school. There were soldiers' gardens at Poona, at Deesa, and at Jullundur. They did not succeed upon the whole ; the men did not take much interest in them. There would be no great advantage in making them more general. Wishes it could be done, for it is excellent employment and occupation for the men. There are no public workshops. The men employ themselves very much indeed in their private trades, such as shoemakers, tailors, watchmakers, and that sort of handicraft, and they may make a good living by it ; but generally speaking the men do not work at their trades. The men are willing enough to take advantage of any active amusement for which opportunities are given to them ; they are not unwilling generally to make use of the regimental libraries and schools, but they do not like working in gardens. There are no gymnasia used in the European regiments, although they are attached to every native regiment in the Bengal service. Gymnasia would be the very best thing to introduce for India ; the real gymnasia, such as you see in London. Gymnastics should be made a parade. Would be the best thing that was ever introduced into the English army, because it is a thing you could make the soldier do ; of course for gymnastics a man must be loosely dressed ; he must not be obliged to parade stiffly ; it would amuse the men, and excite emulation amongst them ; and little prizes go a long way in those matters. Would strongly advise, wherever circumstances were favourable, that the men should be allowed to have as much field sport as possible. Had a long experience of that, and during the whole time we never checked them ; they were obliged of course to have passes, which were given to the best behaved men. There is no shooting in the very hot times of the year; when the very hot winds came on we made them stay in the barracks ; but we never kept them in the barracks a moment longer than we

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could help; we took away from them as much as possible the idea of their being confined. There is no reason why the system should not be carried out universally; the soldier who does not read much, and does not write, must be a very miserable fellow if he is shut up in a room; tell him that he may go out, and he will not go out. It would be the greatest possible advantage to add large sheds to the barracks where the men could go during the day; hardy men do not care for the heat; they do not care for punkahs, although they like tatties, but the tatties are not of any use; they always have the doors of the rooms open. A great deal might be done by having good reading rooms, which do not exist at present. The soldier likes to be read to, because he does not read easily himself; if a man will read to them, they will listen to him. Where there is a fluent reader they enjoy it, and they like men to tell stories to them.

DRESS.
3238 to 3247.

The present dress is excellent. Cannot suggest the slightest improvement in that. The clothing is remarkably well done by the quartermaster, but the boot as given to the soldier was never used by him; it was what they called "made over." They are taken to the shoemaker's shop, and then they are taken to pieces, and then made up again to fit the soldier, at a certain expense. They use the woollen sock in marching; some soldiers grease their feet. One thing of the greatest possible importance in marching is, to have a halt after the first half-hour's march, to allow the men to put their shoes to rights; it is always in the first half-hour that the men find out the pinch, and that halt, after the first half-hour, is one of the most important halts of the day.

DUTIES.
3252 to 3259.

The usual routine of the soldier's duty in India is as follows:—At gunfire, he goes to parade, and, as a general rule in barracks, he gets his breakfast at eight o'clock; at half-past ten he parades again in the barrack, when the officers go round the barracks, to see that they are clean. Then there is a roll-call again at dinner-time, and a roll-call at evening parade; then he has his supper. After that time he is free till tattoo, which is at eight or nine o'clock, according to the season. There are roll-calls during the night in all barracks, if men are supposed to be absent; it is done by the serjeant-major, and that is by what is called the check-roll; if there are two or three men absent the check-roll is called. The soldier is on guard for 24 hours; he does not come on guard above once in 13 or 15 days. He is 13 nights in bed for one night out. The amount of duty performed in India is less than in England; there are no fatigue duties, or very few, compared with what they have in England; for instance, the fatigue duties of sweeping out the barrack-rooms, cooking, and carrying dinners to the men on guard, which is the most cruel thing upon the men at home, of all the duties thrown upon the soldier. That the soldier has nothing to do with in India, because his cook always goes with him. Men in India are waited upon instead of waiting upon themselves.

HILL STATIONS.
3261 to 3272.

There is no doubt about the men in the hills looking better than they do in the plains; they are more rosy; but yet, looking at the returns, there does not appear to be any difference in favour of the hill stations, but rather the contrary. At Deesa and Poona the mortality was precisely the same, 26 in 1,000, while at Subathoo, Kussowlie, and Dugchai it varied from 36 to 39. Taking the stations in the plains of India, in the flat country, for example take Umballa and Jullundur, thinks you will find that the difference in the mortality is rather in favour of the plain stations; as for the difference in the appearance of the men nobody can have a doubt about it. The 32nd regiment was sent to Kussowlie weakened by fever coming from Peshawur, and the

men died like rotten sheep of fever and dysentery. The great objection to the hills, as at Mussoorie, where there is no table land at all, was the filth of the stations which lies very much under the houses, and there is great difficulty in carrying out any sanitary arrangements with the natives; there are nuisances about in all directions, and the consequence is that when a flood of rain comes down the nuisance is intolerable. There is great difficulty in the way of having the drills in all the present stations on the Himalayas from the want of level ground, but not so in the Neilgherry hills. *Col. E. H. Greathed, C.B.*

There are many things to be thought of in frequently changing stations. In going to a station very heavy expenses fall upon the officers of the regiment. They must buy a messhouse, and they have to be in debt very often for the money which is partly lent by the canteen fund; then they have to get up cricket and other things for the amusement of the men, and very often on the march things are thrown away, or are lost, and the consequence is that there is a heavy expense incurred on first going to a station, but thinks that about three years will clear a regiment handsomely. There is a very good allowance made by the Government for a messhouse, and there is what they get from the canteen fund; three years will enable a regiment to pass through its service without being hampered by debt, for they must incur debt. Three years is the minimum period for which troops should be kept at one station. CHANGE OF STATIONS. 3283, 3284.

Medical officers will say that the longer a soldier remains in India the worse he gets, and there can be no doubt of it; does not believe in acclimatizing. A soldier is found to serve practically well for about eight years in India, taking him all through. For the first five or six years a soldier is a very good man indeed in India, but after that he begins to break down, and he is not so good as he was. Youths do not improve in India. A regiment goes down altogether in its physique. It is principally the inaction which belongs to the life of a soldier in India that causes the deterioration. SERVICE IN INDIA. 3303 to 3307.

With regard to the marriage of European soldiers in India, it would be a very great advantage to have a certain increase of marriages, that is to say 25 per cent. The number now permitted to marry is 12 per cent. If the women were properly cared for when they were left behind, and had money enough given to them to provide themselves with food, a great deal might be done to remedy the present evil. It is very bad as it is. Married men as a rule are certainly much more free from crime than the others. The very greatest advantage attends the location of married soldiers in detached dwellings. The married soldier will forego any comfort to obtain privacy. In the separate huts the women are able to rear fowls and turkeys, and thus add to their earnings. The best huts are at Hyderabad in Scinde; in those barracks every married soldier has a separate hut with cookroom, wash-house, and privy attached. The system in Bombay, as regards female hospitals, has much advantage over that in Bengal. In the former presidency there is a separate ward for women and children, with a European matron and assistant; in Bengal no European matron is allowed for, and it is essentially necessary that one should be provided. In Bengal also the female ward is merely a part of the men's hospital divided off, but in the same building; this requires amendment. SOLDIERS' MARRIAGES AND QUARTERS. 3309 to 3315.

As regards lock hospitals, if a medical officer chose to propose to the commanding officer of a regiment to establish those lock hospitals there could be no objection, but a commanding officer would not be justified in asking a medical officer to take charge of them, unless it was his wish to do so. Would advocate the restoration of lock hospitals, but LOCK HOSPITALS. 3317 to 3322.

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it is a very moot question. It seemed to be so extremely difficult to prevent a certain amount of tyranny being exercised over those unfortunate women by the native peons.

Sir J. Stirling, K.C.B.

Vice-Admiral Sir JAMES STIRLING, K.C.B., late Governor of Western Australia.

SANITARIUM IN WESTERN AUSTRALIA. 3352 to 3412.

Was naval commander-in-chief on the Australian station from 1854 to 1856; was governor of Western Australia from 1829 to 1839. Believes that Western Australia has advantages over almost every other place as a sanitarium for invalided European soldiers from India. Auxiliary screw steamers would make the passage from Calcutta with great certainty in 14, 15, or 16 days. Swan River would be the most convenient station in point of access. There are occasionally very great heats. When the usual sea breezes fail to come in, the heat is very great in summer, but never so great as to injure health. Convict labour for barracks and roads would be available; and there would be no difficulty in taking native artizans from India to construct any buildings that might be required. There are abundant supplies of timber and stone in the colony. Swan River is not a very good port, but no great inconvenience is experienced. For steamers the inconvenience would be less. As regards the supply of food and vegetables there would be no difficulty. If there were a sanitarium established at Swan River, there would always be a considerable number of convalescents waiting for a passage back to India, who would in part replace the present garrison. If invalids left India in February they would arrive in time to find a mild and moderate climate at Swan River. If an establishment were fixed in Western Australia, the vessels to convey the invalids from India to Swan River, and reconvey convalescents back to India, should be specially devoted to that purpose. The distance is about 4,000 miles to Calcutta.

Dr. J. Bird, F.R.C.P.

Dr. JAMES BIRD, F.R.C.P., late Physician General, Bombay Army.

SANITARY CONDITION OF STATIONS. 3413 to 3432.

Has served twenty-nine years and a half in India, almost entirely with European troops in the Bombay presidency, at Tannah, Matoongha, Sattara, Mahableshwur, Bombay, Ahmedabad, Kayra, Poona, Belgaum, and Kalladghi. Bombay and Colaba possess a warm moist atmosphere for eight months in the year; the rainfall is 75 inches. The dry and temperate period of the climate, viz., from the latter part of November to the middle of March, is the most healthy for Europeans. The daily variation of the temperature is sometimes great, but the thermometer seldom rises higher than 88° or falls below 76°; the atmosphere is nearly saturated with moisture. In May, and the early part of June, diarrhœa prevails, and cholera is both frequent and fatal. True dysentery and gastro-enteric cases of disease, with bronchitis, prevail in June and July. In August, severe forms of rheumatism and gastro-hepatic disease, and of true hepatic inflammation, ending in abscess, are frequent. From September to the middle of November remittents and intermittents are the prevailing diseases. Poona and Kirkee stand at an elevation of between 1,800 and 1,900 feet above the level of the sea, and 60 miles inland. Subsoil, basalt and clay. The surrounding hills belong to the trap formation. The average fall of rain seldom exceeds from 22 to 25 inches; climate comparatively dry and temperate; the extremes of the thermometer are from 55° to 98°, greater than at Bombay. Water supply from an aqueduct, river, and wells. The climate is little inferior to England; European fruits, as grapes

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and strawberries, flourish well in this locality. Belgaum is 200 or 300 feet more elevated than Poona, near the Western Ghauts, and two degrees further south; has a somewhat lower and steadier temperature, the annual extremes being 60° and 92°, with a rainfall of nearly twice the quantity of the other. The rains are generally more boisterous, and accompanied by greater vicissitudes than at Poona. Dysentery, rheumatism, and hepatic diseases are worse than at Poona. Mahableshwur is elevated 4,500 feet above the level of the sea, has a mean temperature of 66·6°, a mean daily variation of 9·7°, and a rain fall of 254 inches. The climate proved less beneficial to sick and invalid soldiers than had been expected. The site of the Colaba barracks was not sufficiently drained, and the barrack floors not enough elevated from the ground. The diseases numerically the greatest were fevers, being sometimes, in October, 85 per cent. of all the diseases admitted. The floors rested upon the ground; you might dig a well within three feet of the surface. The most inefficient site for any barrack is where the water is near the surface; it produces a large amount of sickness and a large amount of mortality generally. Poona is on the trap formation, and very dry, the rock being immediately near the surface. It is in every respect, endemically speaking, one of the healthiest localities in India. At Belgaum there are several ravines and broken ground in the neighbourhood both of the hospitals and of the barracks.

WATER SUPPLY. 3435 to 3439.

The well waters of Bombay generally contain much organic matter. The constant dipping and splashing of the water carriers in India generally will spoil the best water. The coast wells generally contain a very large amount of organic matter. In all cases where water is derived from wells a covered reservoir should be built, and the supply of water to the water carriers should be regulated by stop cocks. Filtration would prevent guinea worm, and a great amount of disease.

BARRACK CONSTRUCTION. 3447 to 3482.

All the barracks on the Bombay side are generally good, consisting of a single story; but they are generally too little raised from the ground, not more than two feet, and they have no circulation of air from beneath. All barracks for warm climates should consist of two stories. The roofs of the barracks should be double. If a barrack is elevated, it would be better that the floor should be of wood, and next to wood of brick. The single verandah barrack is preferable to the double verandah for health. Would recommend large covered-in places for exercise and play-grounds. They might be separate buildings altogether, and open excepting at the monsoon quarter, when they ought to be closed. A day room to enable the men to leave the barracks, and play at chess and billiards, and games of that sort, would be of the utmost importance to them, both with regard to comfort and health. All barracks to be occupied by European troops should be constructed on arches, or double storied. Bad and objectionable barracks, particularly in low localities, are calculated to produce ill health. Kayra, or Ruttunpore, in Guzerat, where fine barracks and stabling were abandoned, on account of the great insalubrity of the station, indicates the injurious effects of swampy ground in front, with broken ravines in the rear.

STATISTICS. 3492 to 3503.

The statistics with respect to European troops in India should be wholly reconstructed in order to obtain accurate results, and the statistical results should be combined with the meteorological and medical observations of intelligent medical officers. The returns which are prepared only to show the sickness and mortality are given with great accuracy, as far as the results go; but they prove nothing, unless they are combined with physiological observations on the effects of climate, and medical observations on the nature

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of the diseases. Better conclusions could be drawn by tracing the history of a particular regiment in India, rather than taking the general history of the different stations. If the troops were resident for seven years at a station, under the observation of an intelligent medical officer, a conclusion as to the healthiness of the station might be arrived at with considerable accuracy. When troops were frequently on the march, and going from place to place, you could arrive at no accurate result.

ABLUTION ACCOMMODATION. 3507 to 3511.

The means of personal cleanliness are not sufficient in barracks nor in hospitals. A distinct ablution room might be constructed for the personal convenience of the men; but still it would not be so complete as upon a better organized plan for a barrack.

RATIONS AND COOKING. 3512 to 3527.

The ingenuity of the native cooks supplies the defects in means of cookery; but there is no very great or elaborate amount of convenience for cooking in any one barrack, or in any one establishment in India. The *dietetic* deterioration of men in India is as important as the *climatic*. There should be a greater variety of food. Troops are much better fed than in England, and the ingenuity of the native cooks supplies the deficiency of the means at their command; but that does not do away with the recommendation that more convenient means for cooking should be provided. There is not greater monotony in the diet allowed to the soldier than there is in the diet of the class from which the soldiers are generally drawn; but then it must be remembered that the labouring classes have both exercise and pure air at their command, and that generally speaking there are not the same deteriorating influences exerted on their constitutions. The beef in India, and the meat altogether, is not of the same quality as it is in England. The waste of the constitution in all tropical climates is considerably greater, and if animal food is properly mixed up with vegetables, so as to be fitted to maintain the general functions in a state of health, the diet should be more nutritious when supplied to the soldier who is hard worked. The amount of meat should be diminished on first arrival. Nature points out that vegetable diet is preferable to animal diet in many respects; but the great cause of the deterioration in health is the continuance of the arrack ration. The abolition of both rich aliment and stimulating drinks for newly arrived Europeans in hot climates, and a prudent abstinence from the use of them, would greatly facilitate the acclimation of northern people to tropical latitudes; and scientific physicians have justly ascribed the greater mortality of the Dutch and English in warm climates, and the greater difficulty of these becoming acclimated to their conditions, to continuing habits and indulgences there that are only suited to cold climates.

INTEMPERANCE. 3528 to 3546.

The abolition of the spirit ration is very desirable indeed in India. Would prevent the sale of the spirits at the canteen. Good Cape wines, with sherbets and effervescing waters, or any other thing to satisfy the thirst, would be much more healthy and suitable to the climate. Beer would be better than spirits, but good Cape wines, and sherbets, with different forms of effervescing waters, would be preferable. Would do away, as far as possible, with the consumption of spirits; would substitute other drinks; and, in the case of European troops newly arrived, would temporarily lower the diet, substituting vegetable diet, with milk, perhaps. Considerable improvement, both as to diet and clothing, might be made for troops on ship-board from England to India. The diseases most fatal to recently-arrived Europeans are dysentery, hepatitis, with fevers, caused by too large a proportion of salt provisions, the continuance

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of the spirit ration, want of exercise, and neglect of the regular movement of the men's bowels, and also from clothing which is unsuitable to the variations of temperature through which the men have to pass. On ship-board provision should be made for the issue of a mixed fresh meat and salt diet, with a portion of compressed vegetables and lime juice, sherbet at least twice a week, clothing suited to the variations of a high temperature, and daily military and medical inspections of the men. Except in cases where the habit is established, and the natural condition of the system is adapted either to beer or porter, neither is the most healthy drink. Certainly would prefer it to spirits. It is a physiological principle that any hydro-carbonised drinks, whether beer or spirits, are more objectionable to men going to a warm climate.

MEANS OF INSTRUCTION AND RECREATION. 3549 to 3559.

The soldiers in India usually play rackets, cricket, quoits, and skittles. Indoors they play draughts, billiards, and they have a good library; but soldiers should be encouraged to work at trades, and to amuse themselves out of doors with gardening during the monsoons and in the evenings; a tea or coffee room should be added to each station. At the very large European stations ample employment could be found for the soldiers who have learned trades. If the barracks were constructed with double stories, workshops for shoemakers, tailors, and such like might be fitted up in the basement story. Europeans so employed are the best behaved men in a regiment. The Government should supply tools, but the men should pay for them out of the profits of their labour. The thing most injurious in many cases to the men's health is this:—After violent exercise, whether on parade or at play, they throw off their clothing and get chilled, and that is the most frequent cause of disease in India; would prevent this by doing that which all Europeans who value their health in warm climates should do, namely, to wear woollen next their skin. Woollen is better than flannel, because that shrinks so much.

CLOTHING. 3560 to 3571.

Woollen articles, such as are made in the Scotch manufactories now, woollen jackets, and woollen belts are quite equal to flannel in their salutary effects upon the skin; and they have not the objectionable quality which flannel has, namely, shrinking from washing. The men ought to have a coloured cotton dress for the hot weather, and woollen coatee and woollen pantaloons, with all the necessary means of warmth during the cold season. A quilted white cotton forage cap with a cover over it, and a similar cover for the shako is as good a means for protecting the head as anything. The cummerbund is very useful in all cases for the protection of the stomach and bowels.

EXPOSURE TO THE SUN. 3578 to 3588.

Heat, apoplexy, and sunstroke in many cases arise from exposure to the sun. If men go from one extreme to another, from confinement in barracks to exposure, they are more likely to be attacked than men who take habitual exercise. Officers never have *coup-de-soleil*, or very seldom indeed. Solar radiation is a very considerable cause; and when intemperance is combined with that solar radiation, the number of attacks will be considerably increased. Toddy and the sun combined are sure to be very injurious. A great mortality took place in the horse artillery as we marched through a great number of date trees, where the men pulled down the pots that are attached to the trees, and drank the contents, and the consequence was that there was very bad fever at our encamping ground, and a great number of cerebral attacks took place, with a very considerable mortality. Sunstroke on marches is not to be attributed merely to exposure to the sun, but to intemperance on the march. The sun may be the immediate cause, but it would not operate in that way upon men who had taken care of

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themselves ; it would operate upon the intemperate men. In marching, troops should arrive at their camp before the sun attains any great amount of heat ; they should march early, before sunrise ; but they should not march at one or two o'clock in the morning, for that is not the most healthy time after broken rest. If the men were ready to march by sunrise, arriving at their ground after a march of 10 or 12 miles, say by eight o'clock in the morning, that would be the best mode of conducting the march. Men do not get much sleep during the day in their tents, and therefore it is desirable that they should have good rest at night. In the hot season it would perhaps be requisite that they should march a little earlier.

CAUSES OF MORTALITY. 3589 to 3595.

Diarrhœa, dysentery, and fevers have prevailed, and have been attended with great mortality from want of due precaution in the selection of sites. Cholera, as an epidemic, appears mainly to owe its development and origin to miasmata, favoured by elevated temperature, and peculiar atmospheric conditions of climate ; this development being greatly aided by preceding established conditions of filthy endemic situations, badly constructed and ill ventilated habitations, unhealthy articles of food and drink, producing predisposition to disease, aided by unhealthy trades, and depraved moral conditions of vice and poverty. The other diseases are mainly local, and miasmatic in their origin. When epidemic disease appears in a station, the men are generally moved out into tents ; the barracks are whitewashed by the engineer's department, and all overcrowding in the barracks is prevented ; frequent inspections of the men who are proceeding to the rear are made by the non-commissioned officers, who report to the medical officer. Pure liver disease, and that accompanying dysentery, are produced by the predisposition caused by high temperature followed by cold. Woollen clothing worn next the skin, warm bathing, and temperance are the necessary measures for prevention. Rheumatism proceeds from like causes as liver disease, the blood being more impure in the former. The precautions are warm clothing and bathing, with attention to the excretory functions of the body. Scurvy is a blood disease, and is analogous in some respects to rheumatism, having its origin in deficiently nutritious diet and damp localities. Guinea worm is produced by the ova of *entozoa* introduced into the system through the water of particular localities.

HILL STATIONS. 3597 to 3631.

As regards hill stations, considers that table lands of 2,000 feet, when favourably exposed to the influence of the sea breeze, and protected from dry land winds are the most healthy. Isolated hills with like topographical conditions are best suited for *sanitaria*. Elevated upland climates beyond 2,000 feet are objectionable. Want of ground for exercise on hill stations is very detrimental to the health of the soldier. Men selected from debilitated bodies of troops in malarious and coast districts should be sent to maritime sanitaria, established in good positions on the sea coast, such as Vingorla, Bassein, Poorbundhur, and Kurrachee, for Bombay, Goozerat, and Sinde, and probably the Sand Heads for Lower Bengal. Mountain stations, inland from the front ranges, should be occupied as prophylactic stations ; in that way they will prove beneficial, making a proper selection of the men to be sent thither. It would be good policy to keep a certain proportion of the troops on upland plains ; but does not think that there would be any diminution in the mortality of soldiers in India if they were permanently located in more elevated hill climates, and brought down for service in the plains. Thinks it would even be greater, and is borne out in that by medical officers of ample experience, Mr. Murray more particularly.

Dr. J. Bird, F.R.C.P.

ACCLIMATIZATION. 3634 to 3662.

There is acclimatization in the plains of India to elevation of temperature, but not to endemic miasmata. Miasmatic influences are removed by hygienic measures in India as in England. They can be removed in a great measure from Bengal by proper barracks and by draining. The constitutions of European soldiers can, under proper training, accommodate themselves to the inherent influences of climate, as temperature, dryness, or humidity, but not to those that pertain specially to localities, as miasmata from damp, filthy situations, which the human system may for a time resist, but cannot be habituated to. The deleterious conditions of the latter are correctible by hygiene. They have indeed been removed at Batavia, where when we occupied it the mortality was frightful. Mr. Money tells us, that from "the effects of "Dutch sweeping, cleaning, and draining, the most deadly city in the "world had become a healthy and agreeable residence." Miasmatic emanations are removable, as in Cadiz or Gibraltar, or any other place where yellow fever may be produced under special elevations of temperature in temperate latitudes by proper draining and proper elevation of the barracks, and by all the sanitary engineering means which are applicable to such cases. No one can doubt that the fever at Gibraltar, or that the yellow fever at Cadiz was produced by local causes even in European latitudes. Would endeavour to place troops upon their first landing under the most favourable sanitary conditions, partly by selecting stations of the healthiest character, and, where a station was unfavourably situated, by doing everything possible to drain the land, and keep the atmosphere around the station pure. You cannot remove the sources of malaria over any great distance, but you can very much diminish their influence on individuals. We know that in the West Indies endemic cleanliess and draining, with elevation, give immunity from disease.

Brigadier-General RUSSELL, C.B.

Brigadier-Gen. Russell, C.B.

SANITARY CONDITION OF STATIONS. 3685 to 3739.

Has served with the Queen's troops in India for 16 years. In Madras, except during the mutiny in Bengal in 1857 and 1858, also at home and in the West Indies. Many of the old barracks in India were very inferior in sanitary arrangements, but the new barracks are generally admirable, and the sanitary regulations are amply sufficient, if the commanding officer and superintending surgeon will only carry them out. Has been longest at Moulmein, Fort St. George, Secunderabad, Trichinopoly, and Rangoon, and has visited on duty Arcot, Arnee, Kamptee, and Jackatalla. At Moulmein each company had a barrack raised from two to five feet from the ground, built of wood; thatched with the leaves peculiar to that country. In Burmah, barracks constructed of wood are cooler and drier than puckah barracks. The barracks at Fort St. George are very bad, especially the ground floor. We had an attack of cholera, which was attributed to a drain which ran close to one of the rooms. The barracks were within the Fort, and no breeze could reach them. At Secunderabad the barracks were overcrowded; they were badly constructed, built in squares, one square within another, and the air could not freely circulate round them all the verandahs were occupied by the troops. A building occupied by two companies and the band was repaired, and the opportunity was taken to raise the walls three feet, and to put on a Bengal roof, by which a current of air was admitted all round, and wire gauze was placed inside and outside the ventilators, beyond the reach of the men. After this was done no serious case of dysentery, the scourge of Secunderabad, occurred

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among the men quartered in this building, and the medical officer who visited it before morning gun-fire, found the atmosphere as pure and sweet as in his own bedroom, which he had just left, while it was very offensive in the other portions of the barracks. This dysentery therefore arose more from the construction, overcrowding, and defective ventilation of the barracks than from their site, although it was in a hollow, with a swamp on one side and an old graveyard on the other. At Trichinopoly the barracks formed a square, two sides bomb-proof and two sides tiled. There were also five detached buildings outside, built of mud, and covered in with thatch. These latter, called temporary barracks, were by far the cooler and most agreeable. The barracks at Secunderabad, and the permanent barracks at Trichinopoly certainly were very badly ventilated, and that had a great deal to do with the disease. The men do not object to ventilation, but they object to its being conducted in such a manner that they have a complete draught upon them. They object to any air coming upon their own persons. A thorough draught is what they object to. The nights in Burmah are close at the commencement, but become cold towards morning; the men threw off their clothes before going to bed, and when they awoke they were frequently chilled, and diarrhœa ensued. That was a cause of sickness, and also among the Burmese themselves their children suffered very much from bowel complaints, caused by the chilly morning air. There is no difficulty in getting repairs executed where required; they were done instantly by the executive engineer. The troops in India have not to pay rent, as they have at home, under the head of barrack damages; fair wear and tear is allowed, and only wilful damage charged. Barracks are whitewashed once a year by the executive engineer or officer in charge of public buildings, and the companies used frequently to whitewash them to the height of six feet. Hospitals also are whitewashed once a year, as often as the medical officer sends in a requisition. The outside walls of the various buildings are coloured every second year. The provision made by Government for cleansing around barracks is ample. All depends upon the commanding officer personally seeing that all under him do their duty in this respect. Requisitions are always attended to. Urine tubs were placed in the verandahs, and removed by the toties before gun-fire.

MARRIED QUARTERS. 3742 to 3752.

In regard to quarters for married soldiers at Moulmein the patchery was not sufficient for the married people. In Fort St. George all the married people were put into a large bomb-proof, which might be described as a hell upon earth. There was no privacy and no ventilation; one crying child would disturb half the place, and this was more than men's tempers could bear in that bilious climate. The scenes which ensued may be better imagined than described. Afterwards an old stable, or some gun sheds, were converted into quarters for the married people, whose health and morale improved from the moment they had separate and respectable accommodation. Prefers huts for the married people. At Trichinopoly huts were built out of the canteen fund, the three per cent. fund and coffee-room fund, but it was entirely at the risk of the commanding officer; the huts cost from 70 to 80 rupees each, and each man paid two rupees a month as rent. There was a regulation against any unmarried man going to the patchery without a pass, given for one afternoon by the commanding officer; the married people found this to be so great an advantage, that if a man did go into the patchery he was sure to be reported, and he was punished for disobedience of orders. That arrangement promoted the comfort and respectability of the married people.

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SOLDIERS' MARRIAGES. 3754 to 3763.

A European married woman was allowed five rupees a month, an Eurasian three and a half, and each child two and a half. Married men are the most healthy, but the difficulty is on the line of march. Would have no objection to see the number of married people increased. We never allowed a man to marry unless he had 50 rupees to start with in the bank. Would increase the permission to marry from 12 to 25 per cent.

MEANS OF INSTRUCTION AND RECREATION. 3767 to 3779.

Besides the usual games we always had our tailors and shoemakers employed, our carpenters were in full work, and often the blacksmith. At Rangoon we had some 50 or 60 of the men employed as clerks in the various offices; before the natives from the other coast came over the men made a great deal of money, and their health improved. The men are decidedly better conducted and more healthy when occupation is found for them. Two companies, and all the tradesmen in the regiment were sent to Jackatalla to clear the ground and build new barracks. Has seen no station at Madras in which at certain times there were not some of our men working in gardens, and they never seemed to suffer from it; we were most particular as to the hours during which they might work, and not getting wet during the rainy season. In Burmah the medical officer narrowly watched them, and kept an account of the men who were at work to see whether there was a larger proportion of them going to hospital, but he found there were fewer; indeed the men became twice as strong, and improved in every respect. Regards the occupation of the men on the plains as preferable to being immured in barracks and leading a listless life. At Kamptee, where the infantry are carried off with apoplexy, the horse artillerymen do not suffer from that disease in the hot season. If workshops were found for them, and the men could work protected from the sun, it would be of great advantage. Everything as to employment of men in workshops depends upon the commanding officer. We had a reading-room crowded the whole day long. It was supported by the voluntary subscriptions of the officers and men, and well supplied with newspapers and periodicals from Smith and Elder's every quarter, and the library contained at last 1,000 volumes, and was attended with very great benefit to the men. There was also a coffee-room, in which the men could have ginger-beer, soda-water, tea, and coffee, biscuits, sardines, jams, preserves, pickles, cheese, bacon, &c. from an hour before gun-fire to tattoo. Nothing of that kind was allowed to be sold in the canteen; the men had no amusements in the neighbourhood of the canteen, but we encouraged them near the coffee-room. We also established a gymnasium at Secunderabad, and for about two months it was in full swing, but after that does not think that half-a-dozen men ever went near it. They got tired of it, there was no excitement; they preferred foot-ball, cricket, and wrestling. A theatre also was a great source of amusement; it gave so many men occupation, and to the actual performers it was rather lucrative. The room was also used of an evening for glee singing, dancing, &c. by the various companies in succession. We took care to keep the canteen as far as possible from the place of amusement. The object was to draw men from the canteen to the coffee-room, the very smell of the liquor being a temptation.

INTEMPERANCE. 3781 to 3789.

There is no spirit issued as a ration in India. Two drams daily for each man on the strength of the regiment may be drawn from the commissariat at the rate of two rupees a gallon, and it is retailed at the canteen at the rate of two rupees and a half. The malt liquor is also received from the commissariat, and retailed at prime cost. At the bar of the canteen each man's name, by companies, is pasted down on

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a board, and against this board there are a number of pegs; there is the canteen serjeant present who supplies it, assisted by another non-commissioned officer, and as each man gets his dram a peg is pulled out; it is drunk on the spot. If the quantity was reduced, it would drive the men to the bazaar for liquor. It is better to rely on indirect influences to diminish intemperance; a case of drunkenness should never be looked over, or any excuse made for it. Treat the soldier with due consideration at all times, so that he may imbibe some self-respect and self control; men are, as a body, very much what they know your opinion of them to be.

HILL STATIONS. 3791 to 3809.

The removal of European troops to the hills would render the maintenance of a larger force necessary than if they continued to occupy the stations on the plains; the sheathed sword must be always in view of the natives. If men were sent to the hill stations in India at first they would enjoy nearly the same health as they did at home; but after going through a scorching in the plains for a few years, if they go to the hills, the probability is it is not so. The plains of India must be occupied, and no expense should be spared to render the stations as healthy as possible. 800 men on the principal roads of communication, or near to a large town, would have more effect upon their minds than 2,000 men upon the hills. Stations have been selected at too great an altitude; for six months in the year the men are living in the clouds; the Himalayas have not the same table land as the Neilgherries. The troops ought to be located where they can be seen, and then a much smaller force would suffice; soldiers are unproductive labourers; the fewer you require the less drain on home.

DRESS. 3810 to 3816.

Does not think that the infantry shako is either a handsome or a comfortable head dress, or serviceable; may say the same of his trousers and his greatcoat; but the objections apply to all climates.

The shako does not protect the temples or the back of the neck; those are the parts which require protection. The neck should be covered. It would be a great improvement if every man had a cummerbund, instead of a belt or braces, round his loins. The great-coat is defective; it soaks up all the wet.

SERVICE IN INDIA. 3880 to 3895.

From 19 to 22 is the age at which a recruit should go out to India. More attention should be paid to the time at which recruits embark; they should land at the very commencement of the cold season, and be marched off at once to the hills to join depôts, where they might remain for a couple of years until their frames were fully set. Depôts on the hills are superior to depôts in this country, less expensive, less debauchery, less sickness, and no desertion. Recruits would grow into finer men, more capable of work, and who would preserve their efficiency longer. Many of these lads contract at home diseases of the heart and lungs, from carrying their packs, over-drilling, and night duty, before their muscles are fully developed. Sufficient attention is not paid to what the troops eat in India. In many regiments toddy is allowed in the barracks; the men require something besides their bread and tea at breakfast, and in some regiments the native cooks are allowed to buy all sorts of abominations, in the bazaars: bad pork, bad eggs, and fowls which probably died of disease.

Col. Sir P. Cautley, K.C.B.

Colonel Sir PROBY CAUTLEY, K.C.B., Member of the Council of India.

SANITARY CONDITION OF STATIONS. 3901 to 3946.

Has served in India 34 years, in the Bengal Presidency. Was six years on regimental duty. After the siege of Bhurtpore was always employed on canal duties, and in the North-west Provinces. Has served at Dumdum, Cawnpore, Sultanpore, in Oude, and Agra, and,

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while serving in the canal department, was at Cawnpore, Delhi, Kurnaul, and stations in that neighbourhood; also at the hill station of Mussoorie, and Landour. Drainage was a good deal wanted in India, but latterly great alterations were being made. Although Cawnpore is situated on the edge of the river, the high water of which even is considerably below the surface of the ground, the drainage is bad, because the drainage of cantonments was generally done in detached bits, and not upon a comprehensive plan; whereas, if the drainage had been carried out comprehensively, it would have been effectual. To give the Commissioners an idea of the state of the bazaars, mentions that the natives build their huts entirely of mud dug out of holes as near as possible to the place where they build. In the Cawnpore bazaar there were ponds full of black mud and all sorts of filth, and the whole place was utterly unventilated, which was a very remarkable illustration of how ill health was produced, not only in the immediate neighbourhood, but all round the place. Pond making as a receptacle for refuse matter is common to every town bazaar in India. They dig the mud for their huts close by, and do not fill in the hole again, and the hole serves to throw all the filth of the town into, where it remains exposed to the sun, and as a bazaar becomes thicker and more populated, those places become more confined and unventilated.

The neighbourhood of a bazaar frequently becomes a very serious nuisance; but these things are very much more attended to now as to laying out bazaars, than they used to be. Would certainly remove all bazaars to the limit of the boundary of the cantonment, and if there was anything within a quarter of a mile beyond, which was very bad, would have that removed also. Would attach great importance to a comprehensive system of draining. If that were done in places like Cawnpore, Delhi, and Kurnaul, there would be comparatively no disease. There has been no system of contour lines established, with the view of fixing the relative levels of the different localities. In the survey of Cawnpore it was directed that the contour lines should be laid down on permanent maps, but without bench marks. Has no doubt that the nuisances referred to did affect health. Was not aware before of the extraordinary mortality, 91 in 1,000, chiefly caused by fever, dysentery, diarrhœa, and cholera, at Cawnpore; but hearing it now, should say that it was on account of the state of the station, the want of drainage, and the filth in the bazaar. The refuse from the bazaar was carried through the infantry station into the river. There are a number of natural ravines running into the river; they are tortuous and very crooked, and get stuffed up with filth, and then the only thing that is done to remedy the evil is every now and then to clean them; but they never give perfect drainage. Cawnpore is a very good illustration, perhaps an extreme one, of the general defects of drainage in India. It is considered a very disagreeable station, because in hot weather there is a great deal of dust. Is not aware that the officers and others who reside there consider it to be an unhealthy station, so that under proper sanitary regulations it might be brought to about the average condition of healthiness for European troops.

Mentions a place called Shamli, in the Northern Doab; it is a large town and very much inundated, and in the rainy season was very unhealthy. It is upon the edge of a little twisting tortuous nullah, which was the only escape for the water, and the road fund committees used to be constantly clearing out this little nullah, and trying to remedy its defects, without, however, coming to any result. This went on for some time, until at last it was proposed to treat this little twisting nullah with utter disrespect and make a straight line of ditch

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from it to the Kirsunni River, and the effect of it was marvellous; there was never any collection of water afterwards near the town of Shamli. The town of Delhi was also taken up under Major Wilberforce Greathed, who was with me at that time, and he was very successful in draining the interior of the city, which was very badly drained before, by a system of under drains running into the Jumna, believes they got rid of the water entirely. From Calcutta upwards all the towns are at present insufficiently drained; that is the complaint which is very generally made, want of drainage. It is obvious why this state of things exists, and it is simply for this reason, that these matters are done bit by bit. When a cantonment is first marked out the first thing ought to be to attend to the drainage, and it is now attended to, but formerly it was not attended to, partly from one circumstance, and partly from another. Cantonments were hastily taken up. On sanitary grounds in such a climate as India considers drainage of the first importance. At Landour the position is very elevated, and there is very little flat ground there, but there are very deep ravines, and all the refuse and dirt is thrown down these ravines and allowed to remain, and so very bad is it at times, that a person is obliged to avoid walking in the neighbourhood. Ordinary precautions are not taken in those hill stations, because they are elevated, and that matter might be better attended to. Ravines and hollow places all about the hill stations make it very difficult to prevent nuisances from occurring. Any stations by such habits of neglect might be made unhealthy, and the more crowded with occupants the place is the more unhealthy it becomes, owing to such neglect. In those hill stations, particularly at Mussoorie and Landour, diarrhœa is attributed to the water; that is invariably the case, has known people going up there take their own water for drinking purposes.

MEANS OF OCCUPATION. 3955 to 3960.

Workshops supplied with tools by the Government, and the employment of the men in their different trades, would be a most admirable way of giving them occupation. Every barrack in the Punjaub has a workshop and a reading room, one at each end of the barrack. There would be no indisposition among at least a considerable proportion of the men to occupy themselves in work, provided it is made worth their while. As exhibiting the views of soldiers themselves on the point, hands in some letters from soldiers, forwarded by General Tremenheere.

IRRIGATION. 3967 to 3990.

It is rather the abuse than the use of irrigation which causes insalubrity, but the abuse is so difficult to remedy that you can hardly accept that as an excuse perhaps; for instance, a native when he irrigates from a well divides the whole of his field off into little squares, or kyaris, into each of which he pours the water from the well separately, and therefore the whole becomes perfectly and nicely irrigated, but immediately he gets a flow of water from a canal he takes away all his kyaris, and lets the water flow over the whole field which, not being levelled, is left one half of it dry and the other so much overflowed that very serious reports have been made by the civil authorities, who were not acquainted with the irrigation of the district, against canal irrigation from that circumstance, whereas it was not from the fault of the canal, but the fault of the people who used the water. Where water is in large quantities, and where it is allowed to stagnate, or where there is a considerable difference in the level of the ground, some parts being dry and some parts being wet, that is the source of malaria. That is exactly the position in which all the rice cultivation is in Italy and in countries where irrigation has long been practised; it is so well known that rice is not allowed to be cultivated within certain distances of large cities—Milan is an instance. Long experi-

ence has shown that irrigation under those circumstances is the cause of ill health. But such engineering arrangements might be made as would get rid of the injurious effects of irrigation. Dr. Dempster found that whenever there was a soil of a very tenacious character, and where the water used in great abundance was allowed to stagnate there, ill health and spleen disease prevailed. Proper levels and proper drainage are required. In short, a combination of land drainage with irrigation. The people must be taught to cleanse their cities, and to economise the water, which they will not do, and besides the fields ought also to be levelled, for the water gets into the hollows while other parts are left dry. *Col. Sir P. Cautley, K.C.B.*

In selecting hill stations, proposes to send up natives one season to clear the ground, and dig it up and plant it, and fence it in, and then either leave it altogether, or leave one or two natives there; and then in the next year to send another party, and in the third year another, and by those means you would be able to judge of the effects of the place. Would follow the same course that the natives do in clearing portions of the forests for cultivation, run away from it, in fact that is done in America and elsewhere. HILL STATIONS. 4003.

Proposes a jet of water in lavatories for the purpose of cleanliness. LAVATORIES. 4010.

REMARKS on TRADES in the ARMY, referred to by SIR PROBY CAUTLEY.

No. 1.

John Parkhurst, late 61st regiment; 21 years' service.

In 1835, in the island of Ceylon, 150 men were selected of different trades to proceed to Newaraellia for the purpose of building barracks to form a station for sick about 8,000 feet above the level of the sea. This they accomplished in three years, and gave great satisfaction. The 2nd Ceylon rifle regiment made all the roads under the command of Captain Thomas. Some of the men saved money, and after completing 21 years, settled there; some were employed by Government; some set up business for themselves; some held situations over coffee plantations, &c. If trade is introduced into the army it will have a wonderful effect, providing they give soldiers a moderate allowance for their work. There are more tradesmen generally speaking amongst the English soldiers than the Irish; the latter are fond of the soldier's life without trade, and are more satisfied in their situation than the English. The Government will always have sufficient men to do all public works, particularly on foreign service. On no consideration should a soldier be allowed to work at his trade until he is acquainted with a soldier's duty. Tradesmen would be the means of teaching those who enter with no trade. Has spoken to many old soldiers on the subject, and they all highly appreciate the idea.

No. 2.

Charles Lovelock, formerly 61st Foot; 13 years' service.

To introduce into the army more work and less serjeant-major's drill (which, knows from his own experience, soldiers very much dislike), would be a great benefit as well as saving, provided it was not compulsory, as that often damps the energies. Feels sure that such a change would be the means of raising the army, both socially and morally.

No. 3.

M. Bowen, a serjeant 21 years in the 61st regiment.

The employment of soldiers in various trades will confer a great blessing on thousands. It will more than anything else prevent so

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much desertion. How much better a man is, in a country like India, who has anything to amuse him or occupy his mind, anything that would keep him off his bed, providing it does not expose him to the sun, than one who lies dreaming away his time on his cot. Quartermasters should not have any control over anything of the sort.

Col. G. Campbell.

Colonel GEORGE CAMPBELL, 52nd Regiment.

SANITARY CONDITION OF STATIONS. 4011 to 4060.

Has served in India nearly five years in the Bengal Presidency, at Umballa, Subathoo, Meerut, Lucknow, Sealkote, and Jullundur, and a year and eight months under canvass. The barracks in India built upon Sir Charles Napier's principle are quite as good as those in this country, but others are not as good. The old class of barracks are generally speaking deficient in upper ventilation There are no openings in the roof or walls of any use : not sufficient generally speaking. No complaints as to the want of ventilation in new barracks. Has frequently found much closeness in the atmosphere at night in old and new barracks. Urine tubs are used ; they should never be in the barrack room where the men sleep, but just outside the barrack room. The barracks are thoroughly cleaned once a year, generally the residents clean the walls once a week. Delays and difficulties arise in getting repairs executed on account of the expense. They are done by a requisition upon the executive engineer ; he has authority to execute repairs up to a certain amount, but beyond that he has to get his estimates approved, and it is in the routine that the delays and inconveniences occur. Drainage is a most important consideration, but it is generally attended to as much as possible. Water has been lying occasionally on the surface when it ought not to have been. If floors are in good repair and perfectly smooth, they are always dry ; but as they are always made of a sort of plaster, if they are broken the substance of the floors absorbs the wet, and it remains. In the new barracks in the ablution rooms there are iron basins fixed in masonry with a tap, and a hole at the bottom of the basin to let the water out, and that is the only way by which you can ensure a fresh supply of water to every man, and prevent them using what may be called second-hand water. The old barracks have ablution rooms, but they have only earthen basins, and no taps. In some stations there are baths, and in others there are not. Always used baths and tubs on the march. Had a tent fitted up with large tubs, and the men used them on the march. It is impossible to avoid a smell when the privies are being emptied in the morning. The sanitary condition of the station bazaars depends upon the zeal and care of the cantonment magistrate, but the regimental bazaars are completely under the commanding officer, and it is his fault if they are not properly attended to. There is some annoyance from nuisance caused at night in all cases. The regiment suffered from sickness at Lucknow partly because they were overcrowded, but the regiment was put into what had been a huge stable ; the executive engineer was directed to put it in order for the reception of the regiment, and it appeared to be in perfectly good order, but just as the rain commenced the cholera broke out in a most extraordinary manner ; after the regiment had got out had the floors examined and then found that there was a quantity of manure several feet deep immediately underneath the plastered floor, and the exhalations from that caused the cholera. The building was surrounded by a very close bazaar, but there was no cholera among the natives ; nobody suffered but the men in that barrack and two men who had been employed in the barrack at work. Upon questioning the men they acknowledged that at night they had frequently been obliged to

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leave their beds from the very great stench that arose at night; and when the ground was opened one of the men who was standing by his side would have fallen down from the power of the stench had he not been supported by another. At Lucknow the water was bad, its badness was accounted for by the circumstance of their having buried a number of elephants near the wells, and those in time had contaminated the soil and spoiled the water to a certain extent.

RATIONS. 4064 to 4082.

With regard to the commissariat, there should be a trained commissariat. At present it is composed of officers selected from regiments; some of them are exceedingly good, and others are exceedingly bad, as far as my experience has gone; there is no special corps. There is a great obstacle in the way of procuring good rations, in fact the system of bribery which exists so generally among the natives has made it almost impossible. The contractor at Sealkote furnished the Government with bricks at eight rupees a thousand, and he had furnished private individuals with those same bricks at five rupees a thousand, and the three rupees or six shillings constituting the difference must have gone somewhere. With regard to the rations, Lord Dalhousie's order, if acted upon, enables officers commanding regiments to secure the best possible bread and meat, but on one occasion was ordered to give unsound bread to the men because the station committee overruled the regimental committee; after a delay of months the bread was analysed and pronounced not to be pure. The order of Lord Dalhousie was plainly disobeyed by the officer commanding the station. The commissariat department in India is in some places good, and in others bad; it depends upon the officers. There are no difficulties whatever in making bread when the troops are on the march; it is the most simple thing possible.

INTEMPERANCE. 4091 to 4111.

Would discourage the use of spirits and recommend the men to take beer instead, but there are certain men who cannot drink beer; it does not agree with them. It is a great pity that bottled beer should not be allowed to be obtained by the men. There has been considerable improvement in the habits of the soldier in regard to intemperance, attributable to many things. The good conduct warrant had a very good effect, and the discipline of the army has been improved very much, more encouragement has been given to the soldier to amuse himself within his barracks, to take care of his money, and save it, and in a hundred ways his condition has been improved.

MEANS OF OCCUPATION AND RECREATION. 4113 to 4135.

No means of recreation for the troops are provided by the Government, except a fives court. A school there must be, but there should be newspapers, pamphlets, chess-boards, draught-boards, skittle alleys, quoits, and every conceivable thing of that kind. The men particularly like reading pamphlets, weekly publications, and newspapers, but the libraries generally are indifferent; they do not change the books often enough. A man going out to India, and being perhaps for three months on board ship, has books furnished to him, and when he arrives at his regiment he finds exactly the same books, and there they remain perhaps two or three years. The men would take to gardens, but we were so constantly moved about that the moment one garden was got into order we went away, and therefore it was a continual labour, and no advantages resulting; and in the same way with trades' work. On first arriving in the country the officers very liberally subscribed about 150*l.* to set up a trades union in the regiment, and we established it perfectly. We got turning lathes, printing presses, and everything of that kind from England, and we had not been in the station five months before we were ordered out of it. They were all lost at last; we could not carry them about with us. Permanent workshops would

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answer unexceptionably well. There should be a spacious building or room for the purpose, which might be used in the evenings as a room to read in, or to take refreshments in, and to be well lighted. The men find a great want in that respect, that the barrack-rooms are badly lighted. Deficiency of light is a universal fault in India. If regiments found tools ready for them at every station, and a place to work in, and materials to work with there would be no difficulty. If a regiment has to find its own tools and to take them about with them, and also to carry about materials, they might get damaged, and the expense would become too great to bear. To establish a trades union at a station would merely require the building, the tools, and the materials. The system to be pursued should be left to regiments, and the men allowed to select their own chiefs or foremen. In going from one station to another you would have to take over the materials and tools from the regiment that you succeed through the engineer's department. The trades should be cabinet-making, and shoe-making especially, which is a very useful trade to the soldier, and a printing-press is a very useful thing to have in the regiment. Used to print all returns, and in fact at Lucknow printed particular papers for the civil authorities there, for they had no printing press ; also a turning-lathe ; that affords great amusement to the men ; and a variety of other things. Things made in these shops should be sold, and a value should be put upon them by a committee. At Meerut we supplied the 81st regiment with 100 pairs of boots, which they could not otherwise have obtained. There are no covered places set apart where the men can occupy themselves during the heat of the day or in the time of the rains, and that is a very great want.

DUTIES.
4148 to 4149.

As regards duties the soldier is much better off in India than he is at home. His ordinary service is not in the least injurious to health.

HILL STATIONS.
4151 to 4165.

In using hill stations a regiment ought to go to a hill station in the first place rather than afterwards. Would put the soldier in the highest place first, and bring him down gradually into the plains. Men who have suffered in the plains are very apt to get dysentery and diarrhœa if they go to the hills afterwards. Every drop of the water that was used in the barracks at Subathoo was brought by mules from the bottom of the hill up to the top, and it is the same in most other places ; they may have wells, but the water that trickles down those hills, of course, must be impregnated with decayed vegetable matter, and if it was caught before that in a clean iron tank it would be always pure, as it is in the West Indies. Diarrhœa and dysentery arise from the use of the bad water, and the same effect takes place at all the stations that we at present have. It would not be altogether safe to leave the great cities of the Ganges without European garrisons ; of course railways will make a great difference, but there are a good many stations in the plains which might be done away with. There might be a considerable reduction in the number of the troops stationed in the plains without withdrawing garrisons from really important posts.

SERVICE IN INDIA.
4176 to 4183.

A soldier ought to begin duty in India not before 20 years of age. As to length of service, some men are better after 20 years' service there than they were when they first went out, and others knock up in a year ; the strongest looking men may be the first to go ; it is impossible to say. Would relieve regiments more quickly ; should recommend that there should be no depôts. Suppose that the establishment of a regiment was 1,000, would send it out, say, 1,500 or 1,200, but would not send a single relief. Would keep them for seven years abroad, and let them bring home whatever number was left.

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The depôt system is bad in every way. Recruits who have been at a depôt, say for three years, are just as unfit to do duty in the ranks as if they had joined the regiment only yesterday, and then they require to be drilled over again. Volunteering is a bad system.

Soldiers' Marriages. 4205 to 4218.

Does not consider it advisable to increase the proportion of marriages from 12 to 25 per cent. Venereal disease is not so common as in England; you have great power to check it. You bring native women who frequent the bazaars to the hospital when necessary. There is a list kept of them. In that way the amount of disease was diminished. In a place like Calcutta you could not do it; but generally in the stations in India you have it completely in your own hands. The best way of lodging the married people is in separate huts. Should say that a house that would hold two or three families would be preferable, because then they could arrange better with regard to their servants.

Cooking. 4221.

Considers the cooking arrangements for soldiers satisfactory.

W. Elliot, Esq.

Walter Elliot, Esq., late Commissioner in the Northern Circars, and Member of Council, Madras.

Sanitary Condition of Stations. 4242 to 4287.

Has served 39 years in India, in the Madras Presidency and in Bombay. Has paid attention to sanitary arrangements as far as regards the health of troops employed in unhealthy parts of the country. In the Northern Circars the greater part of those men suffered severely from fever, and the parties always came back quite disorganized. Had suggested to the Government a series of experiments, to test the quality of the air, the soil, the water, and the general conditions of places which were supposed to be unhealthy, in order to indicate at what places the troops should halt, and at what places they should not. We know that a certain extent of country generally is liable to fever, but we do not know the particular spots, or the conditions, or the seasons, for it varies with the seasons and the elevation; in fact we know but little more than that a certain tract is unhealthy. Perfect immunity from malaria cannot be attained under an elevation of 5,000 feet. We have reason to believe that the miasmata causing fever are for the most part only generated in the night, and if you could adopt precautions against nocturnal exposure in a place which was otherwise not perfectly free from danger, the preservation of health might be ensured. The greatest prevalence of fever is about the foot of the hills. Has known instances in perfectly healthy places where the malaria was blown up ravines by currents of air, and those who slept within their influence were attacked, and died. Recollects a whole family being swept off under such circumstances. You see a mist rolling up the valley with the breeze from the low country, and the malaria is taken up in that way. It is almost invariably the case, that you cannot get to the high ranges without passing through a malarious tract of country. At Ootacamund there is an extensive belt of unhealthy jungle all round the base of the hills, and it is a curious fact that the approach from Mysore by Segoor, which was exceedingly unhealthy, has become much less so of late years, in consequence of the jungle being cut away for firewood. At first many of the early travellers who were detained there at night died of fever. Attributes the improved health to the clearing of the woods and the progress of agriculture. The land about the base of the mountains appears to have been highly cultivated at some former period, and to have been afterwards deserted. Whenever such has been the case those places become subject to malaria. Perhaps the improved salubrity at Segoor may be owing, in

W. Elliot, Esq. some measure, to the renewal of cultivation. If you want a site for a station for Europeans, unless you send Europeans up to try it, you would get no certain results. Stations should be selected by men who possess a knowledge of meteorology, chemical analysis, geology, as well as of the general principles of disease. At present the regiments that are sent out into those districts are utterly disorganised ; you not only lose your men by death, but you have to pension many who are never fit for service again. We are lamentably ignorant of the whole subject of the origin and causes of fever in India ; it has been found that the Shevaroy hills are perfectly healthy, and continue so for a period, perhaps, of 15 or 20 years, and then all at once there comes a sickly season, and all the Europeans on the hills are seriously affected by it, and many of them are swept off ; that has happened twice in his own recollection. In the Madras Presidency there is not the slightest difficulty in keeping a considerable proportion of European troops in the hills instead of in the plains. In the south of India the people are quite intelligent enough to understand our power, and sufficiently aware of its existence. Hill stations might be used for the purpose of sending troops thither fresh from England, or for invalids. Young recruits probably would be better acclimated by passing a season there before they went to the plains. The sick ought to be sent there in a great majority of cases ; but men suffering from liver complaint and dysentery should not be sent to the hills. In the Neilgherries it was always prejudicial to send patients suffering from liver complaint there, but for most of the diseases of India it would be a very favourable change.

MALARIA. 4288. Wherever you see the green tops of the hills rising above the jungle where there is short turf and grass you are almost sure of salubrity. States the following points in regard to malaria. Malaria is rife in certain districts at the close of the S.W. monsoon, whilst in others that season is the most healthy period of the year, and disease makes its appearance at the close of the cold season, and continues during the hot months. The western ghauts between the southern Mahratta country and Goa and Canara furnish examples of the former. In the tracts about the base of the Neilgherries and in those between the Northern Circars and the Nizam's country, the latter is found to be the case. Dr. Kirk, of the Bombay establishment, attributed the sickness prevalent in parts of the cantonment of Sukkur to the presence of magnesian limestone rocks, which had been subject to the influence of volcanic action now extinct ; and Sir Charles Napier confirmed these views by numerous examples which had occurred within his own experience, while serving with the army in Spain and Italy. Dr. Heyne, of the Madras establishment, recognized a connexion between the existence of fever miasma and a kind of granite very frequent in Southern India, distinguished as syenitic granite, which contains a large proportion of hornblende. Wherever this constituent occurred in a state of disintegration from the action of oxide of iron, there fevers of the worst type prevailed. Observed an instance of a similar kind in a village near Badami, in the Southern Mahratta country, which was supplied with water from a small stream flowing through a bed of tufaceous limestone. The inhabitants suffered so much from intermittent fever in consequence, that he persuaded them to remove to a new site, and they were afterwards quite free from the disease. The village was originally situated at the junction of this stream with a larger one less easy of access, and beyond the limestone beds. One family which had always drawn its supply from the larger stream had never suffered. In 1843-4, a large body of workmen employed on the repair of the

Walbhapúr anicut, across the Tunga Chadra river, in Bellary, were obliged to leave the work. Captain Shaw, the engineer officer in charge, and many of the coolies, died, and all suffered more or less from attacks of fever. This occurred in the month of February. Malaria is sometimes carried by currents of air from places in which it is generated to others which are otherwise free from danger. Thus, it is known to have been wafted by the wind blowing up the vallies and ravines on the sides of the Neilgherries to the summits of the mountains, and there to have manifested itself in its most virulent form. Several members of the family of a planter were destroyed by this cause near Káteri on the Neilgherries. In all places subject to malaria the intensity of its influence is in an inverse ratio to its height above the ground. Has seen it stated that the officers commanding the guard at the Salt station near Saugor, have enjoyed immunity from the fever for which that station is notorious by the addition of a fourth story to the building provided for their residence. Malaria does not appear to pass through gauze or muslin, or other media causing it to be minutely subdivided. Colonel Blake, now commanding the Pegu police corps, tested this characteristic with great success when engaged during several weeks in the pursuit of a hill Zemindàr, who fled to the jungles of Rampa, the most deadly tract of Telingana. By a careful observance of the usual precautions, and especially by closing himself within thick cotton curtains whenever he slept, Colonel Blake was enabled to follow up and capture the fugitive without having suffered any detriment from the dangerous country through which the pursuit lay. Places may be comparatively free from malaria for years, and then be suddenly deluged by it in its most virulent form. Places in Southern India, where the elevation reaches to 3,000 or 4,000 feet, are very liable to such alternations. Has met with many instances in which malaria has been generated in districts and towns which had once been populous, but had become more or less deserted. The city of Goa is in this state. Numbers of the wealthiest Hindoo merchants and bankers emigrated to Bombay about 150 years ago, rather than embrace Christianity under the pressure of the Inquisition. Whole streets were deserted and became infected with malaria. To escape the danger, those of the remaining families who could afford to do so, removed to Panjim, an island now forming the most populous suburb of the city. The decay of the muslin manufacture at Dacca was followed by marked increase of fever in the localities abandoned by the weavers, and places which have been long under cultivation are generally liable to miasma when they have been for some time deserted. Cholera has overspread the whole continent of India in an epidemic form, at long and distant intervals. In Tanjore and Madura it was known as the mort de chien in the beginning of the 18th century. It made its appearance again with General Pearce's force on the march from Bengal to Masulipatam in 1767–8 ; and the records of the Northern Circars are filled with details of its desolating effects at that time. It made its appearance again in the armies of the Marquis of Hastings in 1816 ; and every one is acquainted with its last great work of devastation, which was not confined to Asia, but overwhelmed the whole of Europe. Not a year passes without instances of detachments or stations being attacked. During the periodical reliefs it sometimes happens that every corps suffers from the disease, at others only a few. No one can explain why it comes or why it departs. Every precaution that has been suggested, every remedy that has been tried, has proved worthless. All we know is, that we know nothing. The course he desires to recommend is simply that of instituting a careful series of observations, conducted by properly

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qualified persons, on the natural phenomena of the air, the earth, and the water, at the times when, and the places where, the danger is known to exist. Their attention should in the first instance be directed to observations of the temperature at different hours of the day and night; to indications of the ozonometer; to the course and effects of the winds and of currents of air; to the chemical analysis of the atmosphere at different heights and at all hours; to the examination of the strata under all circumstances, whether permanent or in course of formation or decay; to the analysis of soils; to the influence of particular descriptions of vegetation and of vegetable and animal matter in a state of decay; to the analysis of the water in wells, tanks, and streams; to observations on the electrical state of the atmosphere, at all hours, both on the surface of the earth and at the greatest heights above it to which they can be carried; to the evidence of the inhabitants, and to the careful sifting of their statements of their own experience, &c.

R. M. Martin, Esq.

ROBERT MONTGOMERY MARTIN, Esq.

TOPOGRAPHY OF INDIA. 4289.

Describes his topographical model of India, representing an irregular pentagon, with an extreme extent from north to south of 1,500 miles, and from east to west of 1,800 miles; a superficial area of 1,500,000 square miles, and a well-defined boundary of 9,000 English miles. The Himalayan chain and its prolongations, termed the Hindoo-Koosh, bounds it, for a distance of 1,800 miles, and varies in altitude from 16,000 to 27,000 feet. The western boundary of 900 miles supports the plateaux which constitute a large portion of Affghanistan and Beloochistan. The *eastern* boundary is about 1,500 miles in length. On the *south* the shores are washed by the waters of the Bay of Bengal, the Indian Ocean, and the Arabian Sea for 4,500 miles. Has visited India several times, and resided in Bengal about a year. Was in Bombay twice, and visited the Deccan once. Also traversed the interior of Ceylon and the mountain regions there, and has given considerable attention to the climate of our different possessions in Asia, Australia, Africa, and West Indies, North America, China, and Europe, when visiting those countries.

CLIMATE. 4291.

The Climate is materially influenced by other circumstances besides latitude and altitude; as for instance by the aspect of the place being east or west, north or south; and also by its exposure to trade winds and monsoons. Newfoundland and Vancouver's Island are both in the same latitude, one on the eastern side of the continent and the other on the western side; in Newfoundland it is with difficulty that oats can be grown—wheat cannot be grown; whereas in Vancouver's Island, exposed to a western aspect, there is a climate like that of England. So with regard to India; the eastern and western sides have different climates.

SOILS. 4291.

At Hong Kong, in China, there is no marsh and scarcely any vegetation, and yet a rapid destruction of life; the cause was no other but the existence of a mass of decaying granite. The same took place at Koolungsoo, in Amoy, where rotten granite was the predominating feature; but when our troops were removed to Chusan, which has a clay slate formation, the mortality among the European soldiers did not exceed three per cent. Dr. Heyne, of the Madras Artillery, describes the insalubrity of a large part of southern and western India as the result of the troops being placed on granite with ironstone predominating; but when they were removed to the clay slate formation the fever abated, and did not appear at the stations where that formation was manifest. Sir George Arthur describes the same results arising from

the geological characteristics in Bombay. Districts where the cotton soil prevails are comparatively salubrious. The limestone formation in the neighbourhood of the Indus has been productive of fevers. As a general rule elevation, to a certain degree, irrespective of geological formation, is conducive to health. *R. M. Martin, Esq.*

In locating troops on the hills, it is advisable to place them above the rain gauge limit, which varies in different parts of India from 3,000 to 4,000 feet, instead of having them located in spots which are saturated for six months with moisture. The clouds which strike on the Western Ghauts pour a torrent of water upon those ghauts; at Mahableshwur there are upwards of 200 inches of rain; but in Coorg and on the higher portions of the Western Ghauts there is but a moderate quantity of moisture, and you have a clear sky, with a dry salubrious atmosphere. Moisture is one of the most inimical conditions with regard to the health of men whether conjoined with heat or cold. Troops on hill stations require a considerable area for exercise and enjoyment; *ennui* is less likely then to arise among soldiers than where they are confined to a limited plot; the mind is more tranquil where there is a large open space for action, exercise, and enjoyment, and plenty of wholesome air around them; but placed on a ridge or pinnacle, with no means of taking healthful exercise, or engaging in active employment, the mind reacts upon the body, and has to some degree the effect of undermining the physical stamina. The table land near Nagpore is in a central position, nearly equidistant from Calcutta, Madras, Bombay, and Delhi. It has an elevation of about 1,200 feet and is salubrious; rain falls every month in the year, and during the winter there is a hoar frost on the ground, where thin ice is formed; the nights are never hot; it is contiguous to a large river, and from what we know of the position of the troops there, and other circumstances, it seems to be one of the healthiest positions in India. This description applies also to Poona particularly, but Mhow and those stations more on the plateaux in the north-west certainly have a degree of heat, whether from terrestrial radiation or from being circumscribed by a great barrier, or from some other cause, which latitude does not justify. This increase of temperature may be referable to the degree of terrestrial heat which varies in several parts of the globe. In several parts of Australia, for instance, the thermometer indicates a degree of heat in the soil above that which is found in any other portion of the earth. HILL STATIONS. 4297 to 4313.

Two of the principal causes of unhealthiness in stations are the dampness of the climate, owing to an injudicious selection having been made of position on the exposed sides of hills, and also an improper choice of sites as to the geological formation of the ground. There is a tendency in diseases which spring from terrestrial poisons to spread themselves along rivers, coasts, or great tracks by some unknown agency, and nothing can be more essential in the formation of camps or the establishment of hospitals than as far as possible to place them out of the reach of such contingencies. There is a point which has been several times adverted to, as regards our military occupations in China. Chusan, which is upon a clay slate formation, was at first deemed the grave of our European troops, but it was not owing either to the unhealthiness of the climate nor to any prejudicial characteristics, but that the troops under Sir Charles Burrell were encamped on or near paddy ground, and that they were fed with putrid meat and rotten biscuit, which had been prepared at Calcutta. The meat was so putrid that the men put into their camp kettles any green herb that they could find, and drank the water out of the rice fields. They were sent every CAUSES OF DISEASE. 4315 to 4405.

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day in full marching order to a distance of about two miles to get these provisions, and bring them back in the heat of the sun, and the result was that the Cameronian regiment was nearly destroyed ; dysentery set in, and deaths rapidly ensued among the men, but no officers died, because they had good provisions, and were exempt from the causes which operated so unfavourably upon the men. Generally speaking, an elevation contiguous to the sea has a great advantage ; there is a purifying influence near the sea shore from the frequent change of currents of air. Some parts of the Rajmahal hills about Bhaugulpore seem to be very healthy and favourable for the location of troops. Sooner or later Calcutta will be the mere mercantile capital of India ; it will be like Liverpool in England, and the seat of government, sooner or later, must be placed higher up, and in a more central place in India. The elevation of the Rajmahal hills ranges from 2,000 to 3,000 and 4,000 feet, and in some places as much as 5,000 feet. The country is fruitful ; but there are forests of great extent, and there is a deficiency of water. The health of European troops in some parts of the Deccan is nearly the same as that of European troops in any other country. There is a healthy region in Bundelcund. Generally speaking, the finest portion of the population of India are those who occupy Malwah, and that comparatively high table land : the Rajpoots probably came into India among the early emigrants from Scythia, and have maintained their puissance and their vigour, except where the use of opium has diminished it. They are living in a climate, warm, it is true, but in a region about 2,000 feet above the sea. Does not entertain the idea that the children of European soldiers, or their parents, in India, may not be able to preserve the stamina necessary to carry out the policy of the dominant race. Thinks it a mistake to suppose that because children born in the heat of Bengal or in Bombay, and who have no physical stamina do not live unless they are sent to Europe, therefore children born in a different climate would not thrive. The stamina and power of the Rajpoot race, from whatever period they came into India, has remained undiminished. They possess great physical strength, stately forms, and in mental power all the attributes of highly civilized men. The food of the people in Upper India is principally wheat and legumes of different kinds ; the food of the people in the lower region is generally rice. The better class of Hindoos, the baboos of Calcutta, eat animal food ; they consume kid, and eggs, and fish and milk, and always butter, "ghee," made from buffalo's milk. The Mahommedans were able to maintain their dominion of India for several centuries, by means of fresh hordes who were brought in from the adjacent colder regions. Their troops were continually recruited by large bodies of new forces ; and it was by those superior races that they maintained their dominion. The Mahommedans did not come down and place their forces on the delta of the Ganges. They maintained their seat of power in the upper region. There is no region in Hindostan, except at a considerable elevation, that can be called temperate ; where the grape can be grown for the production of wine. In the loftier altitudes of the Himalayan range you get into a region so arid that leather actually crumbles in the fingers like tinder, and a slain animal could be reduced to dust in twenty-four hours. Generally speaking, in Africa, a large quantity of rain is only unhealthy as it sets organic matter in fermentation. Was in Delagoa Bay, on the east coast of Africa, with three vessels of war in 1823, and we lost the greater part of the crews from fever. We went back the next year at the dry season, and the men were employed night and day. Accompanied them up the rivers in every direction, and we did not lose a single

R. M. Martin, Esq.

man ; but we were not there when the solar rays had acted upon the intense moisture, and the malarious influences which dank vegetation gives rise to. The Coorg region in India, which is from 4,000 to 5,000 feet high, possesses a climate above the rain gauge, and possesses a bold, healthy mountain race, a people with energy and force of character. The Terrai lies along the Lower Himalayas, where there would be great moisture ; it is covered with forest and dank vegetation, yielding at all times a pestiferous gas. It varies in breadth from 20 to 30 or 40 miles, according to the retreating spurs of the Himalayas. It extends more or less all along the range, and at the foot of all the great hills in India something like the Terrai always is to be found. Along the Malabar coast there is an unhealthy region, owing to the vast quantity of water that pours down from the ghauts over the dank vegetation which is to be found in deep valleys, where the rays of the sun seldom penetrate. Those points are all unhealthy to a certain extent. Evening fogs are common in India, in all the low, damp countries. Found no evening fogs at Poona, the soil there being very dry, and the region elevated ; but in Bengal, in the whole of Lower Bengal, the fog at night, the moisture precipitated is considerable, and the Hindoo, in going out at evening, throws the end of his muslin robe across his mouth, and breathes warm air through the muslin to avoid the injurious effects of that fog. These fogs certainly affect the natives of India ; and a peculiar disease called beri-beri, is very much caused by damp ; the native soldiers were particularly subject to it, when placed in damp positions, or in foggy regions. Localities where these fogs prevail should be avoided, or at all events the troops should sleep above the level of the fogs. All the lower stories of barracks or hospitals that he has examined in tropical parts of the world were unhealthy. A pestiferous gas arises from the earth in the tropics where there is vegetation and moisture which is inimical to health and life; this gas does not rise to any great extent, but slowly commingles with the surrounding atmosphere. Has observed the lower story in a fog while the upper story was more or less out of it ; and it is observable that the Hindoos endeavour, as much as possible, to sleep in an upper story, or if they do sleep in the lower story they wrap something entirely round the head, to prevent their breathing anything but the warm air ; that having a peculiar power of neutralizing the poison in a miasmatic atmosphere. The occupation of the lower floors in barracks and hospitals is not at all objectionable on the mountain ranges.

A. Grant, Esq.

ALEXANDER GRANT, Esq., Surgeon-Major, formerly personal Surgeon to the Marquis of Dalhousie.

HILL STATIONS. 4407 to 4473.

Has resided about 20 years in India ; during three seasons in the Himalayas, one season in the Neilgherries, and one at Newera Ellia, the sanitarium of Ceylon. Has reported on the subject. There is nothing in the climate or in the circumstances of the country in the Neilgherry hills which shows that it would be inexpedient to quarter there a large body of European troops. It is very accessible by railway, and it has the advantage of being very near the sea ; it is an intertropical hill station, and more salubrious than some of the Himalayan sanitaria. There is ample table land, the residents can drive about in carriages, which they cannot do at most other hill stations, and the cost of provisions, which is in general high at the Himalayan stations, would not be so considerable there : the railway will have the effect of equalizing prices everywhere in India. On the Neilgherries there is a great deal of cultivation, and a great deal of pasture land. A good deal of the supplies might be got there, but the indigenous

A. Grant, Esq. native population is very sparse, and, therefore, the market is not a large one, almost everything comes from the plains. If a large station were established there the emigrant native population would no doubt increase, but the indigenous native population are absolutely dying out on account of their habits ; and the hill climate is not popular with the native servants, they feel the cold, and suffer from it in consequence of their apathy and disregard of warm clothing. There is for invalids a great advantage in the Neilgherries in this respect, that you can move from one side to the other, and thus escape the rains altogether. The climate benefits chiefly persons suffering from debility and dyspepsia, and the sequelæ of fevers, in fact almost all cases except organic affections of the heart and brain ; the altitude of the place seems to affect these injuriously. The altitude of Ootacamund is nearly 8,000 feet ; Kotergherry is 7,000, and Cunoor only 6,000.

Water is obtained from abundant springs and rivulets. They have a large lake at Ootacamund, which is formed by the drainage from the high mountains around. The vegetables are as good as can be procured in England. European labourers would enjoy their health at those elevations. The direct rays of the sun are not more powerful than they often are in the streets of London on a summer day. English labourers might be employed without injury to health in various field operations. Going there with their wives, they might have families who would survive to occupy that part of the country, and to cultivate the land. Whether the race can be perpetuated in the hills without degenerating is a moot point, but assuredly children can be reared there in as perfect health as they would be in England. Newera Ellia in Ceylon as a station for troops, taking it altogether, is far inferior to the Neilgherries, and provisions are very expensive. Point-de-Galle in Ceylon is one of the most healthy places in the world for troops. In Bengal the decrease in the mortality of European troops in 12 years is calculated to be 20 in 1,000. Much of this decrease has arisen from one very admirable arrangement that was made by the Government, viz., that the European troops should always arrive in India, or in Calcutta at all events, in the beginning of the cold weather, and not as before, in the hot season. Next to this measure was their mode of transit by steamer up the Ganges, whereby the dangers of the journey have been immensely diminished. After these the improvements in barracks, and certain sanitary arrangements connected therewith, of which the Commissioners are no doubt well aware. Also in the diet of the soldier there has been a great improvement, especially in giving it more variety, and in adding one pound of vegetables, which has contributed much to the preservation of health ; for example, scurvy is much less common now than it used to be in the European army. Further efforts should be made to decrease the mortality by diminishing the number of European troops as much as possible at the recognized unhealthy stations now occupied in Bengal and the Upper Provinces. In the valley and delta of the Ganges climatic influences are so inimical to European life that does not think that the most advanced sanitation as regards barracks, drainage, food, and water supply will largely affect the high rate of mortality which seems to be the penalty we must pay for our foreign occupation. To hold the sultry and malarious plains of Bengal with European troops, and with a death rate that will approach the English standard appears to me to be hopeless. If, therefore, it be politically necessary to have large bodies of troops in the plains, recommends that they should be massed at those stations which are recognized to be healthy, such as

Sealkote, Jullundur, Meerut, Rawul Pindi, Hazareebagh, Bangalore, Poona, Moulmein, and a few others. But upon every regiment coming out to India, thinks it should have a regimental convalescent depôt upon the hills. In every regiment in the plains there are apart from the sick perhaps 200 or 300 men in ill health and weakly, to whom such a change would do much good. They are not absolutely ill, but they are out of health, pale, anæmic, and often in hospital. The bracing mountain air would soon set them up, and many valuable lives would thus be saved. Sickly officers should be selected to do duty with the regimental sanitary reserve, and one of the field officers should always command. Here should be deposited all the heavy records of the regiment; here should be the principal regimental school, the workshops, and gardens. By this means the invaliding and the furloughs to Europe would be much limited, and there would be a great saving of life without any increase of expense upon the existing system of convalescent depôts and hill cantonments. When regiments are ordered on service, it would be a great advantage to be able to send to regimental hill depôts all the weakly men with the women and children, instead of leaving them in large barracks in the plains, where discipline is scarcely possible, and disease is certain, often to a lamentable extent, as has been lately the case at Chinsurah and at Dumdum. The recruits who suffer very much from ill-health might also be drilled at these establishments before proceeding to join their regiments; for it is a very common sight in India to see a batch of recruits drilled into their graves by an injudicious commanding officer or over zealous adjutant. They ought either to be drilled in England or on the hills, where all the reserve depôts of Indian regiments might be stationed. They complain greatly of evening drill in India, it arises a good deal from the drill being undergone after taking a heavy meal. Almost all the stations in Lower Bengal, Dum-Dum, Chinsurah, Fort William, Berhampore, Dinapore are unhealthy. Fort William has now the most spacious barracks in the world, but the mortality there is still about 69 in 1,000. Cawnpore is notoriously bad, Allahabad is worse still. Would have reserves in the hills for a third or a half of the whole force. The best way of preserving the health of regiments is to send away all men who require a change, while those who are in good health should remain to perform the duties in the plains. European troops at hill stations complain of what they feel everywhere, the weary idleness of their lives, that there has been so little done in the way of giving them occupation. Would recommend workshops to be established, and that tools should be supplied by the Government, and that gardens should be provided. A great deal might be done in that way with very little outlay, and it would be popular with the men. With regard to men who had severe organic disease, they should be sent by the long sea route to England, for by that change they have the best prospect of recovery. Officers and men are often sent away when beyond the reviving power of any air. The mountain climate is beneficial whenever there is but a moderate amount of organic disease.

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By far the most fatal disease in India is chronic dysentery, in fact, five-sixths of the mortality in the army arises from diarrhœa, dysentery, cholera, and hepatitis. There is no doubt that dysentery arises from the malarious influence of a tropical climate. Bad water is one of the exciting causes, but it is only one of many, as exposure to the vicissitudes of the climate, intemperance, and bad food. Dysentery which accompanies or follows malarious fevers is of the most fatal description.

CAUSES OF MORTALITY. 4474 to 4483.

The officers suffer less frequently than the men, for the officers are less exposed, and are never crowded together like the men; and

A. Grant, Esq. in his experience the most influential cause of dysentery and cholera is over-crowding in barracks. In jails also has observed the most appalling mortality from bad air, but has not been able with the same clearness to trace extensive diseases to impure water supply either in India or in China.

SANITARY CONDITIONS OF HILL STATIONS. 4484 to 4524.

In the hill stations at Simla, Kussowlie, Subathoo, Dugshai, and the whole of that group of stations, there has been a great deal of diarrhœa, but it has been very much diminished of late by improved conservancy of the stations. At Simla the conservancy was as bad as it could be; the ravines were full of dead animals and the whole ordure of the population, consisting of many thousands. There were no public places for the people to go to except to those ravines, and the effluvium was as strong there as it would be on going into a sewer, for in that rarefied atmosphere evaporation is very rapid. The water would be likely to be polluted by these impurities; it is very scanty there during the dry season. Old residents at Simla used to say that diarrhœa gradually increased as the population had increased. Came to the conclusion that the chief cause was the want of sanitary precautions, not elevation, nor temperature, nor damp atmosphere. In the early occupation of the hills the authorities seemed to think that because the climate was cold, the men might be crowded together, and all sanitary arrangements neglected with impunity; they were thus crowded at Kussowlie with fatal results. Mountain climates are of great importance in the cure of disease. At Darjeeling, in the convent there with an average of 28 children and 11 adults, there had been no deaths during 13 years, although many of the inmates had come from the plains with advanced organic disease. Compare this with the mortality among children in Bengal, which is 83 in 1,000 per annum! We have often found that stations which upon first turning up the soil have proved unhealthy become very healthy afterwards. There is, for example, Pegu, the most healthy division for European troops in India. When he was last at Rangoon, the European regiment then had only 20 men in hospital. It is surrounded by marshy country, in the immediate neighbourhood there is rice cultivation, but the barracks are well elevated, and there is a beautiful clear open space all round, excellently drained, and everything done that the present knowledge of sanitary matters could suggest. The hill ranges may be occasionally visited by cholera. At Murree, out of 254 men, there were 42 attacked, and 31 died. Bad water is a common exciting cause of cholera in India; not much attention appears to have been paid to the chemical analysis of the water in India.

INTEMPERANCE. 4530.

Once served with a British regiment in which intemperance prevailed to a lamentable extent in consequence of lax discipline. At a morning parade there was read a despatch from the Duke of Wellington, in which his Grace stated that he had examined the returns of crime and punishment in the regiment for the four months it was stationed in Bengal, and he believed that in the whole records of the British army there was nothing to equal it, yet in the evening of this day 27 men were flogged for being drunk on duty in an enemy's country. After a change of commanding officers all this crime and punishment nearly ceased, and in the health of the regiment there was a corresponding improvement. It requires great moral courage in the surgeon to lay bare such a cause of disease.

SERVICE IN INDIA. 4537 to 4553.

Ten years' service is a very fair time for a regiment to be abroad, and that is about the present rule. If a regiment is at an unhealthy station a change is absolutely necessary; but if at a healthy station there is no necessity for frequent changes, for it puts the officers to

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great expense, and the men also. No regiment should remain at an unhealthy station beyond two years, for by that time the men are saturated with malaria, their health condition deteriorates rapidly, and their diseases are little amenable to treatment. This happens even with natives; thus at Barrackpore, after the second year, the mortality increases so much that by order of the Government every sepoy regiment is relieved after two years' duty there. In Bengal the present mortality is 69 in 1,000, and in the whole of India 62 or 63. This rate might be reduced to 20, or double the English rate, by limiting the European force at all unhealthy stations, by occupying only recognized healthy stations in the plains, and keeping about half of the force, with most of the women and children, in regimental depôts on the slopes of the Himalayas and the mountain ranges in the Madras and Bombay presidencies, of course with good barracks and sanitary arrangements. It is much more easy to prevent dysentery and other diseases of the same class than to cure them; there would be much more success from prevention than from treatment.

H. Lethely, M.D.

Henry Letheby, M.D.

Is officer of health for the City of London, and also professor of chemistry in the medical college of the London Hospital. The question of the purity or impurity of water has been a prominent subject of investigation by him. Not only he, but all the officers of health of the metropolis are of opinion that bad water is a frequent cause of disease, and that it aggravates some diseases. When there is a natural tendency to disease, the condition into which the water will bring the alimentary canal will tend to establish that disease, or set it on foot; and decomposing organic matter, in certain conditions of decay, in the alimentary canal is sufficient, without any other agency whatever, to cause disease. Is disposed to rank impure water before impure air as being one of the most powerful causes of disease. Dysentery was very prevalent and fatal in London in the 16th and 17th centuries, and long since then. Indeed it has been more prevalent and fatal than it now is up to the time that present changes took place in the water supply. The water supply of the metropolis has materially affected the proportion of cholera deaths in two different visitations. During the epidemics of 1849 and 1854, in certain districts on the south side of the Thames, the character of the water supply, and that only, was observed to influence the severity of the disease. In 1849 both the water companies (namely the Lambeth and Southwark) derived their water from the Thames close to the sewers of the metropolis. In both cases the water was largely impregnated with decomposing organic matter; and the districts supplied with it suffered great mortality from cholera. In the low lying districts it amounted to from 125 to 171 per 10,000 of the inhabitants. But in 1854 the Lambeth Company had changed its source of supply from Hungerford Bridge to Thames Ditton, a point far up in the river beyond the reach of the tide and the influx of sewage, whereas the Southwark Company received its supply as before from the Thames at Battersea. During the visitation of that year (1854), Southwark suffered as usual a mortality of 171 per 10,000 of the population, but the district supplied by the Lambeth Company lost only from 19 to 28 per 10,000. And it may be mentioned that the two companies were competing for business in the same district, and often supplied the same streets, so that neighbouring houses were furnished with water by the different companies. Here, therefore, was an experiment on a large scale, where in the same

Effect of impure Water on Health. 4562 to 4572.

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district were about 300,000 persons, rich and poor, of every condition and occupation, with every circumstance alike but that of the water supply, and yet the mortality from cholera among them was very different, for wherever the Southwark water with its sewage impregnations went the mortality was large, but where the Lambeth supply of comparatively good water was sent the mortality was small.

CAUSES OF IMPURITY IN WATER. 4578 to 4598.

Where there is luxuriant vegetation and the wells are shallow, the decomposing vegetable matter is very far more injurious than the decomposing animal matter. We do not find that the soil has the power of oxidizing decomposing vegetable matter to any thing like the degree that it will oxidize decomposing animal matter. The water in marshy districts is always charged with very large quantities of decomposing vegetable matter. The water at Plumstead, and the country about Woolwich, contains from four to five grains per gallon of vegetable matter. The waters from shallow wells usually look clear and fresh and rather inviting, because of the presence of carbonic acid, which gives them a sparkling quality, and because of their temperature and their slightly saline taste. There is no shallow well at all in London which contains pure water. Shallow wells round London on the average contain 60 grains of saline matter to the gallon, and has known them to contain as much as 150 grains of saline matter, and yet the water is drunk. It contains a large quantity of nitre and decomposing matter. Water which has been made unhealthy by the presence of organic matter rarely gives warning either by smell or taste, particularly in the case of vegetable organic matter, although water charged with much animal organic matter will soon putrefy and become tainted. Decomposing organic matter is dangerous to health, but living organic matter is not so dangerous. We live on organic matter, but when organic matter is undergoing certain kinds of putrefaction it is highly dangerous. It was remarked by Dr. Snow during the outbreak of cholera in St. James's during the autumn of 1854, that the area of the disease was chiefly about a certain pump, the Broad Street pump. That of 73 persons who died of cholera during the first two days of the outbreak, 61 had been drinking the water of the pump; and that the disease did not show itself in the houses of the neighbourhood where the water was not used. It was afterwards ascertained that a cesspool drained into the well.

TESTS FOR ORGANIC IMPURITIES. 4606 to 4617.

Would recommend that every medical officer should be supplied with a solution of permanganate of potash for testing water as to the presence of organic matter. Water should not be allowed to be used without being tested in this way from time to time. It is the best test that he is acquainted with for the purpose of examining water charged with organic matter. If it is necessary to use half a dozen drops of that solution it is a sign that the water contains a good deal of organic matter. Another simple method of ascertaining the presence of organic matter, is to introduce a little nitrate of silver in the water, and to expose the solution to the light; if organic matter be present it will be blackened. Another method is by evaporation, and there is another by applying a solution of gold. If a few drops of chloride of gold be added to the water, and the water be stood in the light for about an hour and a half, the organic matter becomes apparent. The strict chemical mode of determining the amount of organic matter in water is by evaporation and ignition.

MEANS OF PURIFYING WATER. 4619 to 4638.

If organic matter is present in the water in a suspended form, it is very easy to get rid of by filtration through sand, or by the filters which are made by Ransome. A rough filter may be made by putting a glass stopper into the neck of a large funnel, and then a handful, or per-

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haps pint, of well-washed sand. If the water is filtered through the sand, it is deprived of all suspended organic matter. Artificial stone is prepared by Ransome, by burning sand with a soluble silicate ; it is very porous, and filters water very rapidly, but it only removes mechanical impurities. It will not free it from chemically dissolved organic matter, which is quite as dangerous as the suspended organic matter. Another form of filter is a hollow ball of animal charcoal ; it is made by mixing the ground animal charcoal with a little syrup or coal tar, and burning it into a globular form. If that is put into a vessel of water, and the interior of the ball connected with a syphon or piece of flexible tube hanging over the edge of the vessel, the water filters very rapidly through it, and the charcoal arrests the mechanical impurities, and causes the oxidation of the organic matter. This is affected by the oxygen which is always dissolved in the water. Vegetable charcoal is not endowed with anything like the oxydising power which bone charcoal has. These filters have been improved lately by the introduction of the peroxide of iron. They use charcoal, with the peroxide of iron. Filters of animal charcoal and peroxide of iron should be used in India for filtering drinking water. Boiling would change the condition of the organic matter, and render it for the time inert. But it must be borne in mind that the heat only acts for a short time ; putrefaction again sets in in twenty-four hours or so.

SANITARY RESULTS OF PURER WATER. 4642 to 4685.

Considers it one of his most important functions, as Health Officer of the city of London, to look after the water supply of the city. Should not consider a city which derived all its water from wells in a good sanitary condition unless the wells were very deep and below the reach of surface impurity. The great improvement in the health of London is, very probably, a good deal owing to the present improved supply of water. In the seventeenth century dysentery, diarrhœa, cholera, and all those diseases which are now so fatal in India, were almost as fatal in the city of London. The prevalence of those diseases in that century may be ascribed to various circumstances. In the first place the habits of our ancestors were not cleanly. They were not cleanly in their persons or in their houses, and they lived in an atmosphere of filth. Their houses were covered with rushes, in which all the dirt of years was undergoing decomposition and giving off its noxious fumes into the air ; and cesspools also were, at that time, a very peculiar source of impurity. Thinks too that their clothing had a great influence on the production of disease. At that time water was scarce, and habits of cleanliness were unknown. The products of disease were widely scattered, and they found a ready nidus for their growth. Besides which the water, scanty as it was, was bad, and no doubt a good supply of water has had a very great influence on the health of the city. As health-officer, his attention is directed to every circumstance that tends to pollute the air, and lower vitality, and engender disease, as for example, to the accumulation of filth in the houses of people or in the public way ; to the drainage of the soil ; the trapping of every opening into the drains and sewers ; the overcrowding of the houses ; the management of offensive trades ; the ensuring a good supply of good water ; and in point of fact, to every circumstance that will tend to keep down, or to keep out, as it were, the introduction of decomposing matter into the human body, whether by the air, the water, or the food. Experience has proved to us that the drainage of the soil has much to do with the healthiness of the district. The use of pure water is, if possible, of still greater importance during epidemic seasons, and in districts of country in which epidemic diseases prevail. Under such circumstances it would be most

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dangerous to select water sources without previous chemical analysis. There has been a very great improvement in the manner of collecting and distributing water in this country; one of the objects of which has been to deliver the water to the consumer purer than it would otherwise be delivered. Should say the mode of distribution by buckets and carriers is very objectionable, and is likely to give the water organic impurities, and to make it indeed worse than it originally was. The soaking of the water from the soil back again into the well, and the redistribution of it in skins, must be a means whereby an additional impurity must be given to the water independently of that which was in it before. In a country where epidemic diseases prevail would object, in a sanitary point of view, to that mode of distribution. The use of water of marshy districts is certainly among the causes of the intermittent fever of those districts. In a district where dysentery, cholera, and fever prevailed, if the water drawn from wells contained seven, eight, or ten grains of organic matter per gallon, should expect disease, and should be very much surprised if there was no disease. As regards temporary purification of water, a pinch of alum put into water will tend to neutralize the action of organic matter. A better means than that even, is to add sulphuric acid to the water, so as barely to acidulate it, and then you completely neutralize the morbific action of organic matter. But these are merely preventives or palliatives; animal charcoal destroys the organic matter. Alum or sulphuric acid would be useful as expedients on march, but the charcoal filtering would be the most effectual remedy at a station.

DISINFECTANTS. 4703.

States in regard to deodorizing agents that Condy's solution is more powerful as a deodorizer; it is a true disinfectant, and oxydizes the putrid matter, whereas McDougall's liquid prevents putrefaction.

R. D. Thomson, Esq., M.D., F.R.S.

ROBERT DUNDAS THOMSON, Esq., M.D., F.R.S.

CAUSES OF DISEASE. 4708.

Is officer of health and analyst of food for Marylebone. Has been a medical officer in the marine service of the East India Company. Served in India and China in 1832 and 1833. Has had some opportunities of observing the effect of locality upon disease. The amount of disease in the different corps of the Indian army varies very much. Had a good deal of experience in China, particularly in reference to removal of cases of disease from low marshy districts, and has known cases where removal to a considerable elevation seemed to cut short the attack of the disease. It did not appear when the men were immersed in a marshy atmosphere that medicine had much effect upon them. When they were removed from the poisonous locality the medicines speedily took effect. The cases were of ague and fever. In the year 1854 examined many of the localities in which cholera occurred, especially as regards the subject of elevation, and found a very marked decrease in the mortality the higher the elevation. In 1849 and 1854, where the elevation was from 100 to 350 feet the deaths were 13 per 10,000; from 80 to 100 feet, the deaths were 15 per 10,000; from 60 to 80 feet, 26 per 10,000; from 40 to 60 feet, 31 per 10,000; from 20 to 40 feet, 49 per 10,000; under 20 feet, 96 per 10,000. This result is modified to a certain extent by the character of the people. The state of the drainage has a good deal to do with the state of health of the town. At a great elevation you have much better drainage than at a low elevation. In low positions you have the sewage soaking into the surrounding soil, and particularly on the river side you have the sewers tide-locked. Drew this conclusion

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from a careful examination of the wells of London, and other towns, where he found the wells very much contaminated with matter in the form of ammonia and nitric acid, which are the representatives of a decomposing state of animal matter derived from the surface. The condition of wells would very much depend on the nature of the sewers, and their proximity to the sewers. The sewer contents in many cases filter into the wells.

Impurities in Water. 4737 to 4747.

Shallow wells become impure from organic matter on the surface and that percolating from the sewers, which gradually changes from the first condition into ammonia, and the carbon or charcoal of the original water changes into carbonic acid and dissolves the lime. This ammonia gradually passing through a porous soil is changed into nitric acid. The best tests are the presence of ammonia and nitric acid. Whatever tends to keep the surface in a foul condition, whether it be defective drainage or defective surface cleansing, will tend to increase the impurity of the water in the wells more rapidly than would otherwise occur. There was a proposition made to expend a large sum of money in constructing new wells to increase the water supply of Glasgow. Examined a number of these wells, and considered them highly detrimental to health. They contained large quantities of nitric acid and ammonia, and they ceased to carry out the project. Various sources were examined for the supply of pure water, and now Glasgow is supplied with the purest water in the kingdom, the water of Loch Katrine. In March last, found the water in the City of Glasgow to be of the same composition as the water in the loch itself; the total impurities were 2·35 grains per gallon, of which only 0·605 is organic. The City of Glasgow spent about three-quarters of a million for the supply. The water acted readily upon the clean surface of lead; after some time this action ceased. An alloy of lead and tin was much less easily acted upon than pure lead.

Indian Water Supply. 4754 to 4761.

Considers that the water in India, procured from tanks and wells, is likely to be injurious to the health of the soldiers. His experience of the tanks has been quite shocking. They are very much more impure than the shallow wells of London. The tanks are open, and persons bathe in them. There is continually a quantity of organic matter which gains access to the water, and these waters are generally quite turbid. The water is disturbed by the constant dipping in of buckets, and the dust flies in. They are quite uncovered; people walk down by steps into these tanks and bathe in them. In the rainy season impurity is washed into them. Tank water is the surface drainage.

Diseases caused by bad Water. 4770 to 4800.

An outbreak of cholera in London was connected with a pump in Broad Street. It was a shallow well; 92·06 grains per gallon was the total impurity, 7·8 was the organic impurity. A lady who had been in the habit of residing in that district went to reside at West End, Hampstead, and she expressed a wish to have some water from that pump; the water was brought to her, and she was very soon afterwards attacked with cholera, although no case of cholera had previously appeared in Hampstead. A very remarkable case occurred on the south side of the river, in the district supplied by the Lambeth and Southwark water companies, during the cholera epidemic of 1854. Upon going to the houses in Lambeth supplied by these two companies indiscriminately, was enabled to tell, upon analysis, which houses were supplied by the Lambeth and which by the Southwark Company, but by no other means except by analysis; the people did not know it. The Southwark Company got their supply

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from Vauxhall Bridge. The Lambeth Company obtained their supply from Teddington Lock, at Hampton. The houses supplied by the Lambeth Company contained a population of 166,206, and those supplied by the Southwark Company, 268,171. The deaths from cholera, in the Lambeth houses, were 611, and in the Southwark houses, 3,476. The deaths estimated by the Lambeth ratio, in the Southwark district, were 976, and, therefore, concludes that there were destroyed by the Southwark and Vauxhall company 2,500 persons. The special element in the water to which the fatality of this disease was due, was the organic matter. The mortality from dysentery, cholera, and fever in India would be, no doubt, reduced by better water. Would certainly not be satisfied if the population of Marylebone obtained its water from the same or nearly the same source as the army in India now gets its water. Should think that a very dangerous state of things. The health of the population can never be secure unless the water is of good quality.

SOURCES OF WATER. 4835 to 4864.

In selecting water sources, would before all others take a pastoral water, that is to say, a mountain drainage, the drainage from land in its natural state. Next to that would be agricultural drainage, which would be probably a river. In other words, the pastural drainage would represent the sources of the river, and the agricultural drainage would represent the river on its passage through agricultural districts. Of course the wells are most impure. The rivers are the next most impure, and the least impure is the mountain drainage. Natural springs are nothing more nor less usually than pastoral drainage. The purest water is obtained from the primary rocks, such as granite, and mica, and clay-slate, such as you have in the Highlands of Scotland. In the river Dee, at Aberdeen, the water has four degrees of impurity, coming from the slaty districts. In such a country as India, where bowel disease prevails, any quantity of organic matter in the water is objectionable. Vegetable matter is not so dangerous as animal matter, but our great object is to get as little as possible. Rain water is the best of all in the plain of Bengal; it may not be so palatable. Our great fault with regard to rain water is, that we do not catch it soon enough. It might be collected from roofs, in iron tanks, or slate, as may be most convenient. In India, all the elevated grounds would supply the best water for troops. You can get an enormous quantity, for instance, from the Khasia hills to the north-east of Calcutta; you have from 500 to 600 inches on the southern frontier of those hills.

DRAINAGE AND WATERSUPPLY OF BARRACKS. 4871 to 4878.

As regards drainage of barracks it is essential that the sewage should be carefully removed. What he has seen, for instance, in Bombay is very objectionable; the sewage there passes into the sea; and you can smell it at low water, because it is not properly carried away. It is most essential that it should be attended to with reference to the health of the locality. Has seen it so offensive that you cannot go to look at some of the most beautiful scenery in consequence of the smell. The native burying grounds are in a very objectionable state; you can see the jackalls pulling the bodies up. There is one other point which it is important to notice, namely, the want of occupation for the soldiers in a plain. The men would be probably more healthy if they had games of recreation; and their time would be occupied in some better way than it now often is. The want of occupation predisposes to disease. Another point is, that from the absence of pure cool water I believe the men are very much inclined to drink. Attaches very great importance to this.

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A. H. Hassall, Esq., M.D.

MICROSCOPICAL ANALYSIS OF WATER. 4897 to 4943.

Has had great experience in the examination of water for many years past. It is an undoubted fact that impure water is in many cases the source of disease. That has been proved by the mortality in the two cholera epidemics in London, especially the epidemic of 1854, in the case of the water of the Southwark and Lambeth company, and also that of the well in Broad Street. General experience is most unfavourable to the quality of the water in shallow wells. Has found that the quantity of solid matter per gallon in the water of the shallow wells in London varies from 60 to 180 degrees. The water from the Thames, as now supplied by the water companies, contains about 20 grains of solid matter per gallon, and this can be hardly regarded as a very pure water. Should say that the water supply derived from shallow wells at Indian stations, not in the neighbourhood of great towns, would be probably impure; but it would altogether depend upon the character of the soil in which the wells were situated. If that soil contained much organic matter, then the water in the wells would inevitably contain a considerable quantity of organic matter which it would take up by percolation through the soil. Shallow wells may collect impurity from a distance of very many yards; should say within 100 yards, and if the impurity were very great, and if it was a very large cesspool, the water would be polluted at a greater distance than 100 yards. Would be very doubtful whether shallow well water in agricultural land would be fit for use for drinking purposes, because agricultural land must contain a large amount of organic matter necessary for the growth of the crops upon it. If a well in England was sunk in the middle of a field, the water in that well would be unfit for drinking purposes. It would not be so impure in the middle of a common; but still there is always a quantity of organic matter in and on the soil of commons which would tend to render the water more or less impure. The purest of all water is that which comes from mountain land. If rain water at an Indian station could be collected on a surface that was not liable in itself to become contaminated, the water would be of a pure quality. It is frequently the case with the water of wells that no warning is given by taste, smell, or appearance of the existence of impurity. Well waters are most grateful, as far as their flavour is concerned, because of their coldness. Examined the waters of the Thames during the cholera epidemic with the microscope, and found that they abounded with organic productions of different kinds, both animal and vegetable, dead and living. The quantity was very large indeed, both in the water of the Thames taken at different points, and in the water of the companies taken from the service pipes of houses, and from the cisterns. The examination of water with a view to determine its quality, should be partly microscopical and partly chemical. The water should be examined by the microscope as soon as collected; a few drops should be placed in a glass cell, and be examined with the half and quarter-inch object glasses, by which means any organic productions contained in it will be discovered. These productions will, however, be better seen, and be obtained in larger numbers, by pursuing the following method:—Half a gallon of the water, collected in a scrupulously clean glass bottle, should be set aside for some six or eight hours, so as to allow of the subsidence of any sedimentary matters it may contain; this should be carefully collected and submitted to microscopical examination. When the quantity of sediment is very minute, it may be thus obtained. All but about half a pint of the half gallon of water

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originally set aside should be poured off so as to disturb the sediment as little as possible. The remaining half pint should be transferred to a conical glass of suitable size, and after three or four hours all but two or three drachms of this should be decanted, and these should be placed in a still smaller glass for subsidence. The chemical examination need be conducted only so far as to determine the amount of solid matter contained in the water. For this purpose an imperial pint of the water should be evaporated nearly to dryness. The residue should be transferred to a small porcelain or platinum capsule of known weight; the dish in which the pint of water has been evaporated should be thoroughly cleansed with distilled water, the rinsings being added to the contents of the capsule. The whole should then be evaporated to complete dryness, and the capsule and its contents weighed. The difference between this weight and that of the empty capsule gives the amount of solid matter, inorganic and organic, in the pint of water; and this, multiplied by 8, furnishes the amount per imperial gallon. By burning off the organic matter and weighing the capsule again, the amount of organic matter per gallon may be ascertained approximately. If the amount of residue, organic and inorganic, exceed some 30 grains, the water in most cases may be regarded as impure. The determination of the amount of organic matter in any water is an operation of considerable nicety, and can only be accurately performed by a practical chemist. However, it is not in general difficult to arrive at a tolerably safe conclusion as to whether the organic matter in any water is in small or large amount. Thus, if during the progress of drying the residue of the evaporated water this residue does not turn brown or black, but remains white, or brownish only, then the quantity of organic matter in the water is but small; if, however, it does turn deep brown or black, and if, especially, it chars and burns, giving out a disagreeable smell, the amount is considerable. By the above means, and where no chemical assistance can be procured, a tolerably exact opinion as to the quality of any water may be arrived at. The examination of water by the microscope is very simple, and might be practised by any person of intelligence; though it is better not to limit the examination to the microscope. It is well that the water should be examined chemically to the extent of ascertaining the amount of solid matter in the gallon. An hospital assistant or an assistant-surgeon could carry out a process of that kind.

Col. W. Thompson, C.B.

Colonel WILLIAM THOMPSON, C.B., Commissary General, Bengal.

COMMISSARIAT. 4951 to 5039.

Has served in India 34 years and upwards in the Bengal Presidency; for 26 years in the commissariat department. Officers are selected for that department and appointed on probation; at the end of a year they are examined, and if they are found qualified, they are appointed permanently to the department. They are selected from regimental officers, and examined by a committee of officers. Officers remain in the department from 20 to 25 years. Although the commissariat service is not in form special and separate, yet, in substance, it becomes so. The officers are specially trained to their duties, and if not found efficient they are turned out. As they have no voice in receiving or rejecting the rations, they cannot be open to any temptation in this respect; there are, however, regimental subordinates, who contractors believe can aid and influence in the receipt of bad rations. Does not think that there are any irregularities on the part of the officers of the department. The regulations of the service framed for the good of the soldier, if acted up to, are sufficient to prevent such, and to ensure

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articles of the best quality being provided. With regard to the quality of the rations, all depends upon the commanding officer; it is solely and entirely in his power to raise the quality of the rations, if bad, to the proper standard, and to keep them at it. As commanding officer, should have no difficulty in obtaining for the soldiers under his command the best article the country could produce, by adhering strictly to regulation, prohibiting all subordinate interference with the rations, and never receiving a bad article. Everything is supplied by contract; as the contractor enters into a bond to supply an article of a first-rate quality, subject to the approval of the regimental authorities, it rests with commanding officers to reject any article disapproved of. The contractor has to deposit security to the amount of one-fourth of his total year's expenditure, and upon five rejections taking place in a month he loses it; he also binds himself to pay a fine of 50 rupees for each rejection. The decision of the regimental committee is final. Formerly the commissariat officer could interfere, and call for a station committee if he differed in opinion, but his predecessor, General Ramsay, had this order cancelled, to give full power to commanding officers. The commissariat officer, if he thinks the article has been improperly condemned, can submit it for the brigadier's inspection, who, if he thinks the regiment is over fastidious, may point it out and report the circumstance to his Excellency the Commander-in-chief, but he cannot compel the regiment to receive what has been rejected, or otherwise interfere. Bread is the only article which there is any difficulty in getting always good, with reference to the difficulty in getting good soojie, as good bread cannot be made of the flour ground with the Indian hand-mill. Bad bread can only be offered for five days, as the contract is annulled after five rejections; inferior bread ought never to be taken, however inconvenient it may be to reject it. The commissariat officers have no power whatever over the quality of the rations. Tenders are called for by the officer, the acceptance or rejection of which rests solely with the Commissary-General. The commissariat officer has to supervise and to visit the bakery, and to see that the material is what it ought to be; but still he cannot punish without the intervention of the military authorities; he cannot fine a contractor. Everything in connexion with the hospitals is supplied by the commissariat in the same way by contract. The quality of the articles supplied rests with the medical officer entirely; he may reject them if he disapproves of them. The commissariat officer supplies hospital utensils, clothing, and everything. Various attempts have been made to brew beer in India, and there are two breweries now: one at Kussowlie, or near to it, and the other in the hills, at or near Mussourie; but the men do not like it so well as the English beer. They have never succeeded in making beer equal to English beer. Last year Government sold beer at a loss of about 25 lacs of rupees. The meat is poor, but it is the best procurable; there is no grass-fed meat to be got, equal to that which is supplied by the contractors, in the market; that is to say, supposing the meat is rejected, and the soldiers have to go into the market to purchase it, they cannot there get it so good. The meat supplied to the hospitals is the same, grass-fed meat; a sheep is sent whole. The commissariat furnish medical comforts procured from Calcutta, such as wine, sago, and arrowroot. As a rule, the mutton that is issued to hospitals is not good enough for sick men. The commissariat department is also the department of transport throughout India. They carry ammunition, food, and everything in fact, on the line of march. And the system works very well indeed; we have never yet failed. There is a difficulty in getting vegetables

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at all seasons; but that is owing to the taste of the men, who prefer potatoes, and the country vegetables are generally bad, at least they are not liked by the soldiers. The vegetables in the mountain districts are potatoes principally. On the plains they get, in cold weather, cabbage and other European vegetables, such as carrots and turnips, but in the hot weather they get nothing but the country vegetables, and potatoes when procurable. Fruit is supplied to men in hospitals, but not to soldiers in barracks. They complain of the vegetables. They want potatoes, and we cannot always supply them with potatoes. They have commenced now, growing vegetables of all kinds at the stations; just before he left a quantity of seed was ordered to be sent to all stations where European troops are located, for this purpose. The use of potatoes is largely increasing.

MANNER OF SUPPLYING RATIONS. 5062.

The ration of the soldier in India consists of 1 lb. of bread, 1 lb. of meat, 1 lb. of vegetable, 4 oz. of rice, five-sevenths of an ounce of tea, or double that quantity of coffee, at the pleasure of the soldier, sugar, salt, and firewood. With the exception of tea, all the articles are usually provided by local contract. Tenders are called for annually for the supply, to be of the first quality. The lowest tender, as a general rule, is accepted, unless the commissariat officer can assign a sufficient reason for its being rejected. The acceptance or rejection of tenders rests solely with the Commissary-General. The party whose tender may be accepted by the Commissary-General is called upon by the commissariat officer to deposit, as security for the due fulfilment of his contract, one-fourth of the estimated expenditure for the year. Suppose for bread the expenditure to amount to 40,000 rs., he would be required to lodge 10,000 rs.; he is then required to enter into a legally drawn-up bond to supply the article of first quality, subject to the approval of the regimental or medical authorities, and equal to what is used in the officers' mess; he binds himself to pay a fine of 50 rupees for every rejection by committee, and in the event of five rejections by committee occurring in thirty consecutive days, to forfeit his security deposit of 10,000 rupees and to have his contract annulled; he binds himself to abide by the opinion of the regimental committee, and to consider it final. The commissariat officer, who formerly could interfere and call for a station committee if he differed in opinion, has now no voice in the matter, all he can do if he thinks the regiment has improperly condemned the article, is to submit it for the inspection of the officer commanding the station, who, if he concurs with the commissariat officer, may report the matter to his Excellency the Commander-in-Chief, but he cannot compel the regiment to receive what has been rejected. Thus it is in the power of the regimental authorities to raise the rations of the soldiers to the proper standard, and to keep them at it. The order making the opinion of the regimental committee final was issued on the recommendation of his predecessor, General Ramsay, to give full power to commanding officers, and, by cancelling the former order, to do away with the prevalent opinion that commissariat officers take the part of contractors to the prejudice of the soldier. The commissariat officer, having no voice in the matter of receiving or rejecting rations, is not the person the contractor would select to bribe; there are, however, regimental subordinates, who he considers can sometimes afford him material aid in passing bad rations, at all events, they make him believe they can, and so extort money from him. To check such irregularities the regulations framed for the good of the soldier are ample, and ought to be strictly adhered to, and no subordinate interference with the rations should be allowed. As commanding officer, with such regulations,

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should have no difficulty in obtaining for the soldier under his command the best article the country could produce; would rather put the soldier to temporary inconvenience for five days, and so get the contract annulled, than receive an inferior or bad article, which the contractor will undoubtedly tender if he think that to prevent such inconvenience it will be received. The meat ration is the only one for which it is difficult to fix a standard; the other articles, being of first quality, can be tested by what the officers have on their own tables, but the beef and mutton being only grass-fed will not bear comparison with that fed on gram and boossa (or chopped straw) at eight or ten times the cost. The medical officer, also, in receiving the articles of diet, should not permit interference on the part of the medical subordinate (or steward), but himself inspect and reject such as do not come up to the proper standard.

Col. H. M. Durand, C.B.

Colonel Henry Marion Durand, C.B., Member of the Council of India.

Attention given to the Health of Troops. 5091 to 5094.

Has served from 1830, until nearly the present time at a great many stations, first in the department of public works; afterwards in the canal department, and subsequently a great part of his career was political, excepting when he was on military duty with armies in the field, which occupied a considerable portion of the time. Was with Lord Ellenborough as his private secretary when he was Governor General, and had an opportunity of witnessing from the time he arrived in the country the very great care and attention which he paid to the subject of the sanitary state of the European troops. The Governments in India have none of them failed in doing what was in their power, to put the condition of the European soldier in India upon as favourable a footing as it was possible to do. It has necessarily been a somewhat difficult process, but it has been partly rendered so by events, various circumstances of course have prevented that uniform perfection in barrack buildings, and attention to everything which would otherwise have gone on gradually increasing. Lord Ellenborough paid great attention to the hospitals, both European and Native. He was under the impression, which must be even more felt at this day, that it was really a matter of national importance to the service in India to pay attention to the soldier, to his comfort, and to take the utmost care of his health. Recent events render it still more imperative, and still more of national and imperial importance, that everything should be done to improve the health of the soldier in India.

Means of Occupation. 5102 to 5116.

As regards employing the men, you ought to have Europeans wherever you have large magazines, and in connection with them a system might be introduced under which an officer in charge of a magazine, wanting assistance in the way of skilled labour, might employ a certain number of men, usefully and profitably to themselves, and profitably to the public service. Thinks that the system of gardens and workshops which have been attempted has failed, partly because it is not so much that the soldier dislikes work, but it is that he dislikes work which has no apparent utility in it. You are putting into the soldier's hands arms of precision, and a great deal depends upon the intelligence of a man, upon his fineness of hand and fineness of touch, all depending upon the development of his intelligence, and what is here suggested would work towards that end also, and therefore would be useful. This work can only be regarded as auxiliary and occasional, therefore it must be a kind of work that may be interrupted. There is scarcely any work that the European

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soldier can be put to which would not be more cheaply done, looking at the result of the work, if done by native labour. You would be paying him an amount for the work done, greater than you would pay if you employed native labour, but you would be gaining, perhaps, in another way, namely, in the health, comfort, and contentment of the men. The plan might be tried of having a station garden, not appropriated to the particular regiment which might be at the station at the time, but to be maintained for the use of the station generally, and which might be carried on in connexion with the station, the men who happened to be quartered there working in it, and what was grown in it being purchased on account of the troops.

HILL STATIONS. 5122 to 5135.

Does not think that any large portion of the troops can be permanently quartered in the hills without detriment to the military occupation and holding of the country. If you throw up the key points of the country and withdraw the troops to the mountains, you practically evacuate the country; it is one thing to prevent a disturbance and to keep the country quiet, and it is another thing to lose provinces and to have to retake them; hill stations are exceedingly useful, for instance, in the way that Mr. Grant spoke of. Troops can be advantageously placed on the hills, if you consider a portion of the troops in India as being really a reserve. But it is only with a very moderate portion of the European troops that you can deal in that way; and it is entirely dependent upon your having more troops in the country than are absolutely requisite to hold the country; at the present moment thinks that we have rather more troops than are absolutely necessary for holding the country. Railroads will facilitate the use of hill stations. As a general rule we ought to avoid dotting the country with little petty works, and we ought to concentrate our European troops as much as possible in a few points. It would be most dangerous not to occupy the great strategical points, on which the security of armies in the field, and on which the security of your hold of the country depends; you must hold them.

SOLDIERS' MARRIAGES. 5137, 5138.

Is wholly in favour of an increase in the proportion of soldiers marriages if it can be done, because a married man is a more contented, a happier, and a healthier man; he is necessarily exempt from many of those things to which single men are exposed; the difficulties which attend it, with reference to general service, and with reference to the position and condition of the women altogether are very great, and make the question of exceeding difficulty, and however much one's feelings might go in favour of extending the privilege in India, must say that it is not at all clear that it would, taking it as a whole, be an advisable thing.

FIELD SERVICE. 5141.

Everything considered, the arrangements on field service in India are as good as they can be; has seen them very hardly taxed on more than one occasion, and never saw them break down.

DUTIES. 5142 to 5154.

As regards parades and drills, a great deal depends on the wisdom of the commanding officer; the wisdom of a commanding officer is really a thing of very immense importance in India, for almost everything is in his hands; he must maintain discipline, he must maintain the state of efficiency of his corps, and in a climate of that kind, unless he does so, having paid great attention to the times at which it is best to carry on his drills, and to all those internal arrangements which rest entirely with him, unless, in fact, the commanding officer is a man of wisdom, his regiment may suffer very likely severely. Looks upon it as a part of the duty of the commanders-in-chief at the different presidencies, and of the adjutant-general's department, to see that the commanding officers of regiments, when they enter into that country

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for duty, shall receive a careful warning as to the attention they are to pay to their men with reference to drill and with reference to every other part of their duty. It would be a very difficult thing to lay down precise rules, because the country varies so much and the climate varies so much; and it is better to hold the commanders in-chief and the adjutants-general responsible, that they do not neglect the supervision of the commanding officers, and not only that they make the commanding officers do their duty upon those points, but if a commanding officer shows himself not fit for his place, to remove him.

The inspection by the general officer is a heavy marching order inspection, and necessarily the men are kept standing for a considerable time, and not moving, it is a very trying parade; the inspections of Queen's troops in India take place in April and October. The object would be attained better by having every man's kit displayed at his feet, he standing by his knapsack and his kit. Soldiers on parade at drill suffer more by standing still than by moving about. Has seen it not only in India, but before he went to India. Would recommend that very great discretion should be exercised as to keeping the men standing. The regulations on the subject of marching are admirable.

SANITARY SERVICE. 5167, 5168.

All stations which must be held admit of improvement in a sanitary point of view. Sanitary improvements may always go on; has scarcely seen a station in India where improvements could not be carried on; it is a question of expense. With due care and attention it is, humanly speaking, within our power to reduce the ratio of mortality. Has always observed that a soldier, after a certain amount of service in India has a great falling in in the chest; a man seems to fall in in the chest, and has the appearance of being a physically less powerful man. This would be remedied by the use of gymnastics to a certain extent, and for this reason, you will find among the men who have a good deal of exercise with their arms, for instance, the cavalry and artillery, who have one way or other a good deal more physical exertion to make, it is less so than with the infantry, therefore thinks that gymnastics would prevent it.

Sir C. Trevelyan, K.C.B.

Sir CHARLES TREVELYAN, K.C.B., late Governor of Madras.

SANITARY STATE OF FORT ST. GEORGE. 5238 to 5263.

Served 12 years in Northern India in the Civil Service, and was for 14 months Governor of Madras. Describes important improvements made in Fort St. George. The ventilation, the drainage, and the protection from the sun were all extremely imperfect, and quite sufficient to account for its previous unhealthy state. The great sanitary agent at Madras is the sea breeze, and by reducing the sea wall of the fort six feet, the sea breeze was admitted into every part of the fort to an extraordinary degree, quite beyond our expectations. We assisted the action of the sea breeze in the barracks by opening some doors which had been blocked up and by enlarging the windows on the sea-side; we also made two large openings into the patcherry, or the married men's quarters. These arrangements sufficed to remedy the ventilation. Then, with regard to drainage, we caused a large cistern to be constructed on the top of an old powder magazine, and had a steam pump annexed to it, for the purpose of filling it with water from the sea, and by these means a free flow of water was secured through every part of the barrack, including the upper storey, so that the privies and urinals could be kept constantly flushed; the cistern was on a higher level than the upper story of the barrack. We proceeded to the construction of a double verandah, that is a verandah for each story. We also pro-

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posed to the Secretary of State to construct a "recreation house," on the plan of a large railway station. Underneath this roof, we proposed to have the school rooms, library, gymnasium, tennis court, the place for skittles and bowls and single stick, the reading room, and all the institutions connected with a European soldiers' barrack, intended for instruction and amusement. We thought it was calculated to diminish the depression of spirits arising from the monotony of barrack life, and that it would save the soldier from the hazardous alternative of either moping in barracks, or going out into the sun to the injury of his health. The same improvements were applied to the general hospital, an old useless town wall and also a range of sheds were taken down, and the sea breeze was freely admitted to the general hospital with precisely the same happy effect. The general hospital at Madras was a solid capacious building of one story, said to have been an old Dutch warehouse. It is situated on the banks of the Cooam river, in which the water is influenced by the tide and by the rains, and the situation is quite open to the sea breeze ; nothing intervenes between the outer walls of the hospital and the sea. But the banks of the river and the drainage had been neglected. Found an open drain leading from the centre of the hospital to the river filled with the most offensive matter ; so much so that it was a very disagreeable thing to pass near it. The river also, instead of being dredged, embanked, and the water made sufficiently deep to cover the sewage from the hospital and town, was in many places very shallow, so that the sewage was exposed to the air. But the main cause of the unhealthiness of the hospital was the intervening walls which shut out the sea breeze. No hospital could be healthy under such conditions of drainage and ventilation, however salubrious the situation in other respects might be.

SANITARY CONDITION OF MADRAS. 5277 to 5309.

The soil of Madras is very healthy ; it is pure fine sand without any vegetable matter whatever ; the only possible cause of malaria arises from neglect of drainage, which was very bad indeed ; the river Cooam got an extremely bad name, and was considered to be essentially pestiferous ; the cause of the unhealthiness was apparent ; the banks were entirely neglected ; it is a shallow river, which varies according to the season and the rain-fall, and as soon as the water begins to subside, wide banks of sand are exposed. The river is the general main sewer of the town, every sewer drains into it, and as the water fell, the efflux of sewage from the sewers became exposed, and the noxiousness and unhealthiness of it was obvious ; that alone was sufficient to account for all the objections. It is a nullah on a large scale, and in the rainy season the water comes down in great force, and fills the river to overflowing. The esplanade and the Government House grounds are all overflowed, and when the water has risen to a certain point the bund or dam is cut that separates it from the sea, and the river for a time is converted into a running stream, with an embouchure in the sea, and then it silts up again. To return to the drains, which, although a very simple, is obviously an extremely important point ; those town and hospital drains discharge their sewage into the river ; as long as the river is in flood it is all covered with water, but when the water falls the sand is exposed, and then the sewage is exposed also. The remedy that he applied was a very simple one, that of having deep cuts made through the sand, at comparatively no expense, the expense only of half-a-dozen labourers for a week or ten days, to secure a constant supply of water up to the mouths of the sewers, nothing more ; that was all that was wanted ; so that the sewage, instead of spreading over the dry sand, should fall at once into deep water and be covered ; that he had done throughout the town. This

Sir C. Trevelyan, K.C.B.

river is the common sewer of the town. In time of flood, once a year, the filth that is there deposited, is swept out to the sea. Has introduced, with success, the teaching and practice of dental surgery at Madras. The applicants were more numerous than could be attended to, for applications were received from the people in the town, who thought it hard that they should be excluded from similar advantages. The plan has been extended to Bengal. The common opinion is, that the population of Madras is nearly a million. The town spreads over an immense area, but sparsely, the greater part of the area being occupied by houses, each situated in its own garden, so that the greater part of it appears more like a wood than a town. It is about seven miles long by two broad. A fair approximation to the amount of population might be obtained. The census might be taken as it is in Ireland, through the new police. The means of determining whether the population is healthy or otherwise, or what are the causes of death are very defective indeed. The general sanitary arrangements in Madras are deficient, both as to drainage and sewers; the sewers are extremely defective. A great work has to be executed for the drainage of Madras, for the drains are of the most offensive and scandalous description. Does not speak of surface drainage. The sewage is discharged for the most part into open street drains. In Black Town there are some covered drains, and arrangements were made by him, in concert with the municipal commissioners, for flushing them with sea water; but, generally speaking, they are open street drains, which are extremely offensive to everybody passing by. The main cause is deficiency of water; the great object is to obtain an ample supply of fresh water primarily for the personal use of the inhabitants, for the wells are very limited, and many of them are becoming very objectionable. Prepared a scheme for the reconstruction of the municipality, founded on our English arrangements, dividing the town into wards, and proposing that the Government should begin by appointing a commissioner for each ward, and that the council so formed should have the power of borrowing and taxing for purposes of local improvement, and should proceed, as its first act, to take into consideration the sewerage and supply of fresh water; in this way we should at once be adopting the most effectual means of securing for this large population the public benefits of proper drainage and of a proper supply of fresh water and should also institute a municipal system, under circumstances the more favourable to success, because we know by experience that the way to get up a public body, and put it into effective action, is to give it some important work to do, in which it is deeply interested, just as in London. The defect in Madras is not so much the want of drainage, as the want of means of flushing the drains; the town is on a level, and there are plenty of drains, in one sense too many, for they are offensive in the extreme, because there are no means of propelling the offensive matter, and getting rid of it; the only possible means is that of flushing the drains. It is a matter of the highest importance. Not only the preservation of life and health is concerned, but the strength and comfort and general efficiency of the population are involved; they would be better and abler men, women and children for all the purposes of life, if the average standard of mental and bodily vigour were improved by the removal of these local causes of a low state of health. A supply of pure water is an extremely popular subject, and extremely desired by them, and it was the knowledge that it would be at once taken up with the perfect good-will of the community, that induced him to delay action upon it until he had first formed a popular municipal body.

Sir C. Trevelyan, K.C.B.

DANGERS COMMON TO EUROPEANS AND NATIVES. 5309 to 5318.

European troops must partake of the general conditions of healthiness or otherwise of the surrounding population. This may be illustrated by the fact, that a high wall is maintained between the Government House grounds and the body of the town, in one of the most thickly populated portions of the town, expressly for the purpose of excluding the noxious smell that may issue from the drains, thereby excluding the sea breeze, and preventing the improvement of the adjoining part of the town, and thus greatly aggravating the evil.

The spread of cholera is a case in which the general conditions of health sensibly affect all classes of the civil and military servants of the State, so that the sanitary state of our army is more or less mixed up with the sanitary condition of the people of India. And in a capital city like Madras, the matter derives increased importance, owing to the large number of public functionaries who reside there, besides the regular European force ; and the deaths at Madras from cholera and other causes, among Europeans, of late, unfortunately, have been very serious and painful ; the seeds of the disease originating from the native population ; that is the prevailing opinion, and the true one.

[Sir R. Martin here stated to the Commission, that when he was surgeon of the native hospital in Calcutta he always became aware of the advent of cholera 15 or 20 days before it seized the European population, by its being prevalent among the natives, and their being brought into the hospital, so that amongst them it began first, and that was one of the reasons that led him to suggest extended measures for sanitary improvements in Calcutta, which have been carried out since he left.]

Sir C. Trevelyan proposed that the health of the European population in Madras should be improved, not by building a wall of separation between them and the natives, but by powerfully acting upon the conditions of health of the native population itself. It is believed that impure water powerfully operates at Madras in inducing cholera. The water supply is extremely deficient, derived from a group of wells, and it has become partially deteriorated by offensive matter from the drains. The filth of the surface gets into the water. There is an urgent necessity, on the commonest principles of duty to that large population which is intrusted to our care, to provide for them a sufficient and ample supply of that prime necessary of life, fresh water, which, if necessary in other climates, is emphatically so in a climate like that of Madras. Would apply the same remark generally to India, but the strongest case is that at Madras.

HILL STATIONS. 5319 to 5357.

States in regard to the barracks at Wellington, on the Neilgherries, that the site and climate are excellent, and the barracks very well constructed, but doubts if the best manner of using the barracks is to occupy them by a single regiment, because the advantages, whatever they might be, would be confined to a single infantry regiment, all the other regiments deriving no benefit whatever from them ; and it would be extremely expensive, having in view a general system, to apply a hill station barrack in that way. We must hold all the necessary points in the plains by a sufficient European force, so that any force we may maintain in the hills would be surplus to the others. A double force would be required, and that would increase the expense. The expense of provisioning a force stationed in the hills is also very great, much greater than in the plains, and the expense of moving the troops is much greater. When an entire regiment is removed the expense is very serious. The troops stationed in the hills cannot be brigaded and exercised there with other troops, and especially with native troops, for it is very essential to our Indian army that the European troops should be constantly in the habit of being exercised with the native

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troops. Although there is a great deal of fallacy in the prevailing doctrine about acclimatization, still there is something in it ; all Europeans, civil as well as military, require to be seasoned before they come to the state of health best suited for a tropical climate, and if the troops are at once stationed in the hills they do not become seasoned. The rude habit and the full warm generous state of the body which belong to a temperate climate are not suited to a tropical climate, and Europeans arriving in that state are always brought down, often through some serious illness ; but whether they have an illness or not they always alter, and it is necessary that they should alter, in order to give them a chance of preserving their health in that climate. Whatever doubt there may be about acclimatizing the troops, there is no doubt it is important that they should be trained to all those habits of life which are necessary for preserving health in that climate, and under those peculiar conditions of society ; if they are stationed in a barrack on the plains they acquire those habits, but in the hills they do not. There are also many constitutions which are not suited to India ; we see it among the civilians, and no doubt it is so also among the military. If, when regiments are stationed in the plains, the unsuitableness of the soldier's constitution to the climate becomes apparent, he is eliminated, he is invalided or transferred to a regiment in some other quarter of the globe, whereas upon the hills those defects of constitution would not become apparent until the regiment was brought into action. If, therefore, a regiment were habitually stationed in the hills, and were brought down into the plains only when required for active service, we should find breaks-down and deficiencies which we were not prepared for ; the conditions would be new. Then the men dislike the hills. They consider them dull ; there is a want of the excitement of the full tide of human existence which they have in the large stations in the plains. They also complain of a want of certain indulgences which it is better they should be without, and which they can only find in the great towns. Then the married men complain that they cannot practise trades there, and their wives get no washing there, and there is a want of society there. It is more difficult to find amusements for them in the hills than on the plains. The mere strolling about Madras is an amusement, shopping is an amusement, paying a visit is an amusement ; but at Wellington all they can do is to take a sort of Sunday walk, going over the mountains or the jungle, and they walk great distances and get into scrapes.* It is very difficult to employ the men in trades there. At Madras, or at any station in the plains, a man may more or less follow his trade, whatever it may be, and obtain some demand for his work. Workshops attached to barracks are a very desirable object. Upon the whole, troops are better, for their own sakes and for the sake

* Inquired into the cause why so few labourers and artisans from the European regiment had been employed upon the works at Jackatalla, and found that the soldiers would not come forward unless they were entirely excused from military duty on the days on which they were so employed. This appears to be a solid objection. Men cannot apply themselves steadily, so as to give a good day's work, if they are liable to be interrupted by roll-calls and parades. It is so desirable to provide occupation for the European troops, and to husband the insufficient stock of labour on the hills, that he hopes the matter may be arranged consistently with the requirements of military discipline, as it has been in other armies. The same reason is alleged for the neglected state of the soldiers' gardens. This difficulty would not occur in the case of convalescents ; and the general occupation of attending to a garden in a temperate climate would promote their recovery. The maintenance of the trees, walks, and fences might be entrusted to two or three pensioners (many of whom have been gardeners in their youth) ; and the convalescents might be remunerated by a share of the vegetables and fruit.

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of the public service, on the plains than on the hills. No doubt the sickness and the mortality are greater on the plains; but you must have men on the plains, and you must submit to whatever may be the unavoidable mortality and sickness, and all your efforts should be directed to make the stations on the plains as healthy as possible; all your efforts should be brought to bear on the conditions of health on the plains. It would be desirable also to reduce the number of troops serving on the plains as much as it was consistent with the service of the State. Is advocating merely a general system; by no means says that you might not locate troops at a hill station sufficiently near for the purpose of overawing the population on the plains. A portion of the European force in Upper India has been held in reserve in the hill stations, as the European force at Bangalore is in the south. In as far as regards Wellington barracks, would make the Wellington barracks a sanitarium on a liberal scale for the whole of the European army of the south of India and Burmah; would not only send thither the broken down men, who require to be restored, but would make it part of our military sanitary system to watch the cases in which a change of air would be advisable; would make arrangements to enable the non-commissioned officers and privates to resort as freely to the sanitarium as the commissioned officers and civil servants do now. A great deal more might be done in the way of prevention in connexion with the hill stations than in the way of cure; and it would in every point of view be better not to use these stations as ordinary barracks for the whole of troops, whether they specially require it or not, but to appropriate them as sanitaria for the particular men who require a change, men who have begun to suffer from the continued action of the climate. By appropriating the Wellington barracks to this object, this great advantage may be liberally extended to the whole of the Madras European force of all arms, cavalry and artillery, as well as to the men belonging to the military departments, conductors and others, and it would be a frugal and economical as well as an effective application of this sanitary power. At present there is a great waste of that sanitary power; the great majority of the men of the regiment now stationed at Wellington really do not in any sense want to be there. The question of the relative value of the extreme and medium elevations in the mountain ranges was a subject that had been extensively discussed, and the conclusion which everybody had come to was, that for persons in a very relaxed state and far gone, who had suffered very much from the enervating climate of the plains, a lower elevation was preferable. Kunoor was generally recommended, which is somewhat lower than Wellington, the climate being like that of the North of Italy. The climate which was considered to be of the most medium temperature in the hills was at Kotegherry; but it is rather an out-of-the-way place, and is very little resorted to now. It is considered to be the golden mean of all the different climates of the hills. The climate of the highest range of the Neilgherries is a *quasi*-Alpine climate; there is a great deal more rain there, and the climate is harsher and severer. The railroads will greatly increase the usefulness of the central sanitarium at Wellington. Generally the occupation of hill stations must be considered with reference to all the circumstances,—the nature of the country, as to whether it is an open country, the nature of the population, and the hold that we have over their interests and goodwill. Looking at all these circumstances in the South of India, should say that the principle of concentration might be carried out there to a great extent. The population of Southern India is, generally speaking, of a very unwarlike and docile kind, and they have become much more

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so of late ; they have lived under our Government for several generations, and a race has grown up who are unacquainted with the use of arms. The people are very quiet, docile, and industrious, and not at all disposed to create disturbances ; considers therefore that a moderate force, fully equipped for immediate action, in a central situation like Bangalore, would command the whole of the South of India. Does not mean that there should not be proper detachments with their magazines secured in fortified posts, but that our main force should be confined to the central station of Bangalore, ready to move in any direction. The health of the troops would be greatly promoted by that arrangement, and our financial position would be greatly improved. But to return for a moment to the hill stations, by making them a point of union for the whole Madras European army, to which men in a weakly state of health would be sent, the progress of European colonization in the hills would be much promoted ; the men would thus become acquainted with the hill districts of the Madras presidency, which are very important and interesting, and many of them would be induced to settle in the neighbourhood. That is the only part of the South of India where Europeans can colonize at all in the Australian or Canadian sense.

MEANS OF OCCUPATION. 5357 to 5361.

Besides providing men with means of recreation, we have to do with moral agents, and it is necessary for our success in the great object we have in view that we should act upon their wills, and supply adequate motives ; for men do not choose hard study, or the abnegation of ease and enjoyment for their own sake, and they soon get tired of skittles and bowls ; when exertions are made, and self-denial is practised, it is with a view to some ulterior object, such as the improvement of their condition in life, and the main point is to bring that object to bear upon our European soldiers. At present they are in a very unfortunate state in that respect ; they are isolated from the rest of the community ; they know little and care less about all the country interests which occupy the minds of the higher classes of Europeans in India ; they have no objects of ambition, and no motives bearing upon the improvement of their condition in life are offered to them. By the native population they are regarded with aversion and fear. Our Mahommedan predecessors managed better in this respect. The Mahommedan power was founded on a system of military colonization. The Mahommedans first appeared purely as a military people, a military leader with his army ; and in various ways, partly by official employments, civil and military, and partly by actual settlement and colonization, these military bands were converted into component parts of the population, and were transfused into the body of the people, and the remarkable influence and duration of the Mahommedan power are chiefly attributable to this. Now would propose that in a manner suited to the altered circumstances of our system, we should pursue a similar policy. Proposes that we should offer to non-commissioned officers and privates sufficiently powerful motives to influence their conduct, and to induce them to exert themselves for their own improvement. We must look at the matter not only as a military question, but also as a social question. The greatly increased European garrison we shall have to maintain in India will form a very important element of Indian society, and in order to improve our relations with the natives, and to confirm our hold upon the country, we ought to endeavour to leaven the mass as far as possible from this source. The way he would propose to do it is by holding out inducements to the non-commissioned officers and privates of the army of the same kind as those which are held out

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to military officers and civilians, but suited to their position in the scale of society ; that we should encourage them to conduct themselves to the satisfaction of their commanding officers, to cultivate and improve themselves in the regimental schools, and to learn the vernacular languages by offering them the prospect of employment in the police and public works, the commissariat, ordnance, and various other departments where trustworthy European agency would be of the highest value. By so doing we should improve our administrative system, for European agency of a good and suitable kind is hardly less wanted in subordinate than in the higher positions. We should improve the body of the population by leavening the mass, and transfusing into it the best portion of our European lower class. We should improve the troops themselves by giving them a worthy object in life and an adequate motive, and we should so raise the character and prospects of the European military service as to encourage recruiting, and make it an object to a better class of persons throughout the United Kingdom to take service in the army, with a view to improve their condition in India. No doubt, in a strictly military sense, we should lose many valuable men and non-commissioned officers, but conceives that our gains in other ways would far preponderate ; the balance of advantage would be infinitely in our favour. What he proposes is already done in an imperfect desultory manner ; men are taken from the ranks who may be deserving men, and put into the different public departments ; but it is done without any system, and the selection is made by what is called interest, that is, taking a personal interest in a particular man. A liberal transfusion of European honesty and trustworthiness, and the habit of obeying and commanding such as our good non-commissioned officers have, throughout the subordinate situations in the police, would do more for the efficiency of that department, and for raising the tone of morality throughout India, than anything else he knows of. But whatever is done must be done according to a system. Submits to the commission that this is a kind of European colonization, which is eminently applicable to India ; and if a system of the kind he has sketched were adopted, our European garrisons would send forth every year a large number of well-conducted qualified English Christians, who, in all the various walks of life, in all sorts of situations, military, civil, and mercantile, such as assistants to coffee and tea planters, employés on railways, and in 500 other lines of life, would carry English energy and English civilization through all the arteries and veins of the continent of India. We made a small beginning at Madras. Found the civil engineering college in an incipient and doubtful state ; at once decided upon continuing it. Twenty stipendiary studentships were established in connexion with it for European soldiers, and a programme of the necessary qualifications was circulated to the commanding officers of all the European regiments on the Madras establishment, including those in Burmah. Soldiers who could be recommended by their commanding officers for their good conduct,—we considered that as an indispensable condition, whatever their attainments might be,—provided there was *primâ facie* evidence of certain elementary, scientific, and literary attainments, were considered eligible to compete for those 20 stipendiary studentships. The arrangement was highly popular and successful from the first, and in some regiments quite beyond expectation. In regiments where pains had been taken with the regimental schools, the number of qualified persons who applied was so great that it became necessary to have recourse to a preliminary regimental competing examination,

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in order to determine who were to be the candidates for the central examination. In that way we collected at Madras 20 men, who were the pick of the whole army, for the administrative service of the Government in the civil and military departments. The plan was approved by the Secretary of State and his Royal Highness the Commander-in-Chief, and so far as his experience went it was highly successful. Would propose that an extended system should be established on that principle, and that a scale of qualifications should be laid down, the first of which should be good moral conduct, perfect trustworthiness, a power of self-control, and obedience, and then the necessary knowledge of English composition and arithmetic, and an elementary knowledge of the native language which they are now teaching in the regimental schools. The persons so recommended from the regiments should be subjected to some appropriate test, will not say necessarily a competing examination, but they should be selected by some central authority, and should undergo such further instruction and probation as might be considered proper, either in central institutions or otherwise, as might be determined, and they should in that way be worked into the different administrative departments. As regards the effect of these proposals on the health of the army, the disease from which European troops in India suffer is vacancy of mind, want of occupation, *ennui*. Believes that that is the origin of most of the physical and mental evils with which they are afflicted ; and if an effectual remedy could be provided against it, if the most ordinary interest and activity of mind could be created among the European troops, their health would be greatly improved. It would act in both ways, negative and positive ; it would keep them out of mischief, and instead of going to the grog shop, or to worse places, for excitement, they would go to the regimental school for improvement, promoting their future prospects by an interesting occupation, and improving their health by the elevating effect that would have upon their spirits. Would also suggest that a sanitary manual should be prepared, so that the most advanced experience of the present day may be placed in an available form at the disposal of every medical and military officer.

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Physical Conditions in India. 5390 to 5457.

Was upwards of 25 years in the service, furlough in England inclusive. Has paid some attention to the geology as well as to the botany of India. The question of how far the formation of a country affects the health of the persons living in it is not so much a question of geology as one of the physical configuration of the country; and the mere nature of the rocks, or the abstract geological conditions, have but little to do with it. That is, the nature of the soil, and the slope of the great lines of drainage. Suppose that in a tropical country, there is a great river valley with different measures of inclination along different portions of its course, you will have different sanitary conditions at different points ; near the delta, where the water flows slowly, and where there are large alluvial deposits, you will have a very different sanitary condition from what you will find near the head of the valley, where the inclination is considerable and the drainage good. In the delta of a great river like the Ganges or Brahmapootra, it is with difficulty that you can have good drainage, from this simple circumstance, that the mean level of the country and of the delta is hardly elevated above the level of the highest tides. Has known the superintendent's house in the botanical gardens at Calcutta completely surrounded by water. The way in which that is remedied, for the sites of houses

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in the delta of the Ganges, is by digging tanks and throwing the earth taken out upon the surface; for instance, about Calcutta the general depth of the tanks is about 17 feet, and if you dig a tank of the extent of an acre, you can raise the same area either 17 feet high above the level of the flooding, or you can elevate 17 acres a foot high. That is the way in which a considerable portion of the surface of Calcutta has been raised above the level of the inundation. Considers drinking water not necessarily bad by reason of its being stagnant; for when you get a proper balance of vegetable and animal life in still water, there is no other natural condition required to keep that water sound and fit for consumption. So much is this the case in Bengal, that the natives prefer the water of ponds or tanks the surface of which is covered by a crust of *lemnæ* (species of duckweed). Where the tanks are filled with rain-water, whether or not the water is of good quality will depend upon the washing in of the surface, and upon the nature of that surface. If decayed vegetable matter, or animal *excreta*, were thrown out on the surface, and the rain drainage took that direction, the water of the tank would be tainted and unwholesome. The tanks which the Europeans generally have access to are very seldom of that kind; but these remarks have more reference to the habits of the natives in the villages of Bengal, who commonly drink water, not out of what we call a tank, but out of ponds covered with a crust of vegetation. Where you have running water in the upper regions of the valley, you are more likely to have good water and with less care, for you have then got a general good condition, from the fact of its being running water; the act of running brings it so much in contact with the atmosphere, that you have there good water provided without any other natural provision. The troops generally obtain their supply of water from tanks, but the conditions vary very considerably, according to position. In the north-western provinces good well water is procurable in abundance at many stations, in addition to the supply from tanks. The great valley of the Ganges might be divided, along a stretch of 1,000 miles, into four belts. The first or lowest would include the immediate delta of the Ganges, or about 240 miles from the apex of the triangle to its base. Upwards from Allahabad, where the two rivers join, the physical conditions, as regards climate, soil, and drainage, differ very materially from those of the delta and lower provinces. The difference is as great in many respects as if they belonged to two distinct geographical regions; the physical characters of the inhabitants differ, and the food they eat differs. In the one case there is a puny or comparative feeble race who subsist chiefly on rice; while in the north-western provinces the population consumes but comparatively little rice, and they are a more muscular and powerful race. The contrast increases as you proceed northwards through the Punjab towards the Indus. The unhealthiest parts of any country are the deltas of large rivers in a level country; but in tropical and sub-tropical regions, contracted deep transverse valleys covered with forest within the mountain ranges, and shallow longitudinal valleys outside them, are also most unhealthy. The organic matter is first washed down by the rivers upon the delta, it is there spread out on the surface by inundation, it undergoes decomposition, and that decomposition is always concurrent with a malarious condition of the country. During a year the Reverend Robert Everest made a continued calculation of the quantity of sediment brought down by the Ganges opposite Ghazeepore in the different seasons of the year,—rains four months, winter five months, and summer three months. He ascertained that from June to September the average discharge of water was about 500,000 cubic feet per second,

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and for the remaining eight months somewhat less than 60,000 ; that during the former period the average quantity of solid matter was by weight $\frac{1}{125}$ or $\frac{1}{856}$ in bulk. The sediment during the other months was comparatively insignificant. The physical condition that tells most, after mere temperature, upon the health of European troops, is the annual fall of rain, and the hygrometrical condition of the atmosphere ; that is, putting the subject in a very broad form of expression, temperature first, and then humidity ; and where you can reduce the temperature, and at the same time get a concurrent condition of dry atmosphere in India, in that direct ratio will you, as a general rule, increase the healthiness of the climate for Europeans. There is a remarkable physical condition which prevails over India during the south-west monsoon, namely, an atmospherical current which is charged for four months to saturation with moisture, conjointly with a high temperature. This current is intercepted by the Himalaya mountains, and forced to ascend, when it necessarily cools down, and heavy continued rains fall all along the southern side. But when you cross the chain to the northern face this condition ceases, the moist current is arrested, and periodical rains cease to fall. Has stood on a high ridge of the Himalayas between Cashmere and the plains, and seen it raining a deluge upon the Punjab, while not a drop of rain had fallen on the northern side for months. In the upper part of the valley of the Sutlej, in Kunawur, and more especially in the valley of the Spitee, where very little rain falls, and where you have a cool and dry atmosphere conjoined, a European maintains as good health as in any part of Europe. On the other hand, when you cross to the southern side you may have the condition of a low temperature, but concurrent with a protracted fall of heavy rains and charged humidity of the atmosphere, when the climate ceases to have the same salutary effect. A large extent of country is of a favourable character ; in fact all the great valley of Thibet ; but you would not find it suitable in other respects, nor advantageous for maintaining a body of European troops. The country is not fertile, but the reverse. You might feed a certain number of troops there, but should consider it highly impolitic ; it would be like having troops to garrison a town and locating them 100 miles off from the garrison. But when you come to the southern side of the Himalayas you will find many spots which are recognized to be favourable, but not to the same degree, which have got a low temperature, but concurrently with long periodical rains and great humidity. The south-west monsoon is a stratum of atmosphere having a definite altitude less than 15,000 feet ; for if you ascend in the Himalaya to 12,000 feet you have heavy periodical rains ; but go up to 15,000 feet and you are entirely beyond them ; indeed, in some parts of Thibet a shower of rain has seldom fallen within the memory of man during the south-west monsoon. But for the Himalaya mountains the physical condition of India would be very different ; the mean temperature of the whole continent would be lower, and that of China higher. It is the interference of this enormous lofty axis, arresting the monsoon, and intercepting the interchange of atmospheric currents, which is the great cause of the physical difference between China and India. There are some Himalaya stations, such as Mussourie and Landour, at an elevation of from 6,000 to 7,000 feet above the sea, which have a mean temperature of from 8° to 12° in excess of what they ought to have, calculated theoretically, for the latitude and elevation ; while Saharunpoor, in about 30° north, and 1,000 feet above the sea, has a mean temperature as high as that of Canton, which is 8° further south, and at the level of the sea. At Chirra Ponjee, in the Khasia hills, the annual

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fall of rain has amounted to from 500 to 600 inches, or fifty feet. In the month of August 1841 it is recorded to have amounted to 264 inches, and that during five successive days 30 inches fell every 24 hours. At Mahableshwur, on the Western Ghauts, the fall is 248 inches. There is little or no rain at the moderate elevations in Western Thibet, and in the arid parts of Sinde and adjoining deserts of the Punjab. The average annual rainfall in Sinde does not exceed 5 inches; at Agra it is about 20 inches; at Khandalla, on the Western Ghauts, 200 inches fall, while at the foot of the eastern slope only 14 inches are said to fall, and at Poona, a little more inland, 24 inches. The local differences are very great, but they are generally explicable by the relation which the localities bear to the mountain ranges, which arrest or intercept the monsoons. Up the valley of the Ganges, the rainfall diminishes gradually as you advance north-westward towards the Indus, where it is very light. The Terrai is a stretch of shallow depression, or succession of wide flat-bottomed valleys, extending parallel to the Himalayas from the Brahmapootra river to the Indus, or, as more strictly limited, to the Ganges. It is of variable width, attaining in some parts, as between Oude and Nepaul, a width of many miles. It is bounded by the outer ranges of the Himalaya on one side, and towards the plains by a slightly elevated steppe, called the Bangur land. This wide depression is either sheeted with forest, or grass jungle, and patched over with extensive swamps. It becomes deadly during the rainy monsoon, and immediately before and after it. The unhealthy condition is not limited to the human species, who are fearfully liable to bad remittent fevers and their sequelæ, but it also affects the domestic cattle. One winter passed through the Rohilcund Terrai when safe, and at the village of Rooderpoor, where he examined great herds of cattle, found that a very large proportion of them, young and old, had been fired with a hot iron on the flanks, this being a remedy practised by the Hindoos for enlarged spleen. They had also, in addition to enlarged spleen, the flabby look and pallid colour of the mucous membranes which is characteristic of spleen disease as a sequela of fever. Remembers an instance also in the valley of Dehra Doon, where the settlers were carried off by a violent outbreak of deadly fever, which also affected their cattle. This is not connected with any particular form of vegetation or geological formation, and only has reference to the physical condition of the country. There is a wide shallow depression, with an intense development of tropical vegetation, and abounding in swamps, excessively humid and deluged with rain, in consequence of its proximity to the mountains; being the conditions that are conjointly most favourable to the production of malaria. All the principal affluents of the Ganges pass freely through the Terrai; but there are numerous and extensive swamps or jheels, and bad natural drainage. It is a very rich soil of decayed vegetable matter, resting on a substratum of coarse sand or gravel. Disease is there communicated by malaria arising from vegetable decomposition. But the prevalent opinion among the natives of India is different; they look upon the water as being the source of the disease. In the Terrai the physical conditions which affect the water are constant during successive years, while periodically, after the lapse of years, intensely virulent outbreaks of pestilence occur, which are specifically marked by the natives under the name of Aol, to distinguish them from ordinary years. People are seized with Terrai fever, after passing through it in the most expeditious manner, without tasting food or drink that they have not carried with them. Has known cases where it was inconceivable how the disease could have been

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communicated through water. All that part of the Terrai which lies between the Indus and the Sutlej, which is now under cultivation, is dry, and generally speaking as healthy as the adjoining plains; while east of the Ganges it is humid and deadly unhealthy. Where the forest has been removed the country has become perfectly healthy; and there are facts on record which prove the previous existence of the forest; for instance, the Emperor Baber, in his autobiography, mentions that in his descents upon India he hunted and killed many rhinoceros in the forests near Peshawur; that animal has been driven back several hundred miles to the eastward, and is not found now west of the Ram-Gunga. It is rare even there and until you reach the Gogra. The best improvers of climate are a succession of crops and good cultivation.

Irremovable Causes of Disease. 5479.

Excess of heat and excess of moisture are among the irremovable causes of disease in India which tell most upon the health.

Hill Stations. 5481, 5482.

No position for troops would be really good under 5,000 or 6,000 feet of elevation. It might be expedient to make experiments upon some of lower elevation; but you would have so many of those disturbing conditions in force that impress him so strongly, that is to say, intense heat and moisture, at a low elevation, that he considers you would only imperfectly effect the object you had in view. If high land were proposed for a station, would first determine what the physical conditions were as regards structure, configuration, elevation above the sea, temperature, humidity, supply of water, nature of vegetation, and all that class of phenomena. If at a comparatively high elevation, where oaks, pines, and tree rhododendrons grew, should consider it immaterial to interfere much with the forest, and safe to locate troops there at once. Only such an amount of clearance would be made as was necessary or expedient for the particular site. But if the elevation was comparatively low, and there was dense forest extending from the plains up to the margin of the steppe or height, would consider it necessary to make an extensive clearance of that jungle.

Climates. 5487.

With regard to the nature of the climates, and their characteristics, a great amount of valuable information, amassed during many years, already exists in India, relating to most of the subjects, and it does not appear that any separate scientific establishment or expedition for a fresh investigation is required. A measure of that kind extending all over India, would occupy a long time, and be very costly. It seems that it would be better first to collect and put together what is already known, and that could be done by means of the scientific staff of the India Office, with a little assistance. Where information was deficient regarding any particular district that might be made a subject of special inquiry. The principal scientific points of a strictly physical nature that are desired, are the elevation above the sea, range of temperature, rainfall, and humidity, and nature of the vegetation. When you have got these, general and medical observation would supply the rest; there is a medical service spread over the continent including many officers of high and distinguished qualifications.

J. Sutherland, M.D.

John Sutherland, M.D.

Results of Station Reports 5490.

Has examined about 100 sets of replies returned to this Commission in answer to queries relating to the sanitary condition of troops sent under the authority of the Commission to all the stations in India, and the general results of the examination are as follow:—

Water Supply. 5490.

First, with regard to the water supply:—there is little or no satisfactory information as to the quality or quantity of the water, no

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chemical analysis except in one or two instances. Water is obtained chiefly from shallow wells. The quality as described is often inferior and bad, and the means of collecting and distributing are of the most primitive description, and very objectionable as regards health. There has been no application apparently of any modern improvement as regards water supply. Is decidedly of opinion that the condition of the water, both as regards its domestic use and its relation to efficient drainage, is one of the cardinal defects in the sanitary arrangements in India, and a predisposing cause of disease.

CLIMATE. 5490.

Next as regards the replies as to climate :—Except at Government observatories, the means of observing and recording meteorological facts are, with few exceptions, very imperfect. There are remarkably few complaints as to the unhealthy nature of local climates or as to any injurious effect from them upon the health of the troops.

SANITARY CONDITION OF STATIONS. 5490.

As to the sanitary condition of the stations :—The surface cleansing of the cantonments appears to be more or less carefully attended to. There is surface drainage of some kind or other in almost all cases, but no drainage in the proper sense of the word, and even the surface drainage is often imperfect or bad. Privies and urinals are generally without drainage, in the proper sense of the term, and both are often very noxious. The immediate removal of the excreta, such as is practised at the stations, or professed to be practised, is certainly infinitely superior to cesspools. If at any station this system must be continued because it is impossible to adopt a better, does not think it would be safe to allow the excreta to remain over-night, and they certainly ought to be removed at the very least twice a day. The present system admits of very great improvement. Generally speaking, the roof guttering of barracks and hospitals is deficient. The drainage of the cook-houses, ablution rooms, &c., is defective ; it is often received into shallow cess-pits emptied daily, a proceeding which is nothing more than an imperfect and expensive mode of drainage ; or the drainage soaks into the subsoil.

BAZAARS. 5490.

With regard to bazaars :—Some bazaars are reported to be clean and healthy, but generally large populations have grown up close to military stations without order or regularity. There is no drainage except mere surface drains ; the water supply is often very bad and unwholesome, and sometimes it is drawn from tanks, which it is stated are also used for bathing, and for receiving the drainage and filth of the station. The bazaar houses are generally described as overcrowded, and the ventilation as bad. Then with regard to native towns near stations, there is a total neglect of sanitary precautions, and all the usual elements are present which in more temperate climates would predispose to cholera, diarrhœa, dysentery, fever, and epidemics, generally.

BARRACK CONSTRUCTION. 5490 to 5493.

With regard to barracks :—The barrack construction contains the elements of simplicity and healthiness, if these were somewhat better used, but they are accompanied with certain defects, as we should consider them here, in detail. For instance, many of the rooms are too long, and contain far too many men, from 100 to 200 or more. It is impossible to ventilate such rooms efficiently. Quarter company barracks, that is, separate houses for 20 or 25 men, are about the limit to which we should go in this mode of construction in India. There are double verandahs in many of the barracks, which interfere injuriously with the ventilation. The practice of putting more than two rows of beds between the opposite doors and windows is quite inadmissible for barracks or hospitals. Barrack rooms in India should be écheloned and separated to such a distance one from another as would ensure entire freedom of external ventilation between the

buildings. The present construction of the doors and windows is apt to expose the men to draughts; in many instances there are no sufficient means of ventilation when the doors and windows are shut. The cubic space is often very deficient, in other instances it appears large, but from the unnecessary height of the rooms it is above the heads of the men, so as to crowd them on the floor. In hot climates ample superficial area for the men, rather than large cubic space, is the element to be considered. The barracks are not raised sufficiently above the ground, and in very few instances indeed are they raised at all. Where they are raised the plinth is generally filled in with earth paved over, and there is no free perflation of air between the floor and the ground. The consequence is that ground malaria enters both barrack rooms and sick wards. Perflation of air underneath the floors of all inhabited apartments, and entire isolation of the floors from the soil is essential to health in tropical climates. The floors of both barracks and hospitals ought to be raised several feet above the soil on arches; the height varying with the nature of the locality. In low flat positions, troops as well as sick should always sleep on upper stories. *J. Sutherland M.D.*

The zymotic diseases which scourge the Indian population, and occasion the largest amount of loss and inefficiency among our own troops, are the same as those which are known to arise in this climate from want of drainage, defective ventilation, and decayed vegetable and animal matter, bad water, and intemperance, especially spirit drinking. Considering what the climate of India is, the system of dieting the troops cannot be conducive to health. The ample ration, together with the very limited amount of work and of exercise, is beyond doubt a predisposing cause of disease among troops in India. The cooking arrangements are described as of a most primitive description, and the cook-houses are often defective, but at the same time the cooking is not often complained of. There appears to be more continual and habitual tippling of spirits in India than absolute drunkenness. The great body of the evidence goes to show that spirit drinking in India is a potent predisposing and aggravating cause of disease and mortality, and that it ought to be put an end to as a point of public policy. The means of recreation, instruction, exercise, and occupation, both out of doors and indoors, are everywhere most deficient. Hence there is no sufficient inducement for the soldier to occupy himself. The tone both of mind and body is lowered, and the soldier's only resource is idleness or vicious indulgence. Want of exercise, and the listless manner in which the soldier in India passes his time, is another potent cause of disease. CAUSES OF DISEASE. 5494.

Hospitals are constructed on the same general principles as barracks with verandahs, sometimes single and sometimes double; the inner verandah is sometimes used for sick, a practice which is inadmissible. The position of the hospital is generally good, but sometimes it is in dangerous proximity to privies and open drains, or to other nuisances infecting the air in the wards. There is often deficient cubic space, and deficient surface area per bed; the hospitals have no drainage; the water supply is the same as that for the barracks, and open to the same objections, as to the source from which it is obtained, and its manner of collection and distribution. There are no water-closets, and the latrine arrangements are most defective, often very offensive, and in such a climate, unwholesome. There are hardly any suitable lavatories for the sick, and no proper bathing arrangements. There is no perflation of air under the ward floors, and the sick are exposed to ground malaria in consequence. The ventilation of the hospitals is often defective. The burial grounds are generally sufficiently removed from cantonments, and properly regulated, but sometimes they are in the heart of cantonments, and bazaars, or native towns, and give rise to nuisances. HOSPITALS. 5494, 5495.

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SANITARY SERVICE. 5495.

Medical officers have hitherto had no definite powers as to sanitary matters, and their influence in preventing disease has been uncertain and ill-defined. The new medical regulations of the 7th October 1859, issued by Lord Herbert, would be applicable to every station in India, and would effect immense good.

HILL STATIONS. 5495.

There is a remarkable unanimity of opinion as to the propriety of locating troops on hill stations, especially during the early years of service. There is at the same time sufficient evidence to show that sanitary defects exist at those hill stations, as well as at stations on the plains, and that those defects lead to injurious consequences. The practical result is that whether hill stations are occupied or not, sanitary considerations must be equally attended to, otherwise hill stations will be of very doubtful benefit.

SANITARY ADMINISTRATION. 5495 to 5507.

There is in India no sanitary administration in the proper sense of the term, for preventing disease, whether as regards the construction and arrangement of buildings, water supply, ventilation, or drainage, and the present unhealthy state of the troops is to a great extent the legitimate result of the absence of a sanitary system, and to the same cause is to be attributed the high rate of mortality, and the great prevalence of epidemic disease among the native population. There is no evidence of the existence of an officer of health in India furnished by any of these returns. To meet the local circumstances, the sanitary administration in India should be made a special one. There is no order and no system. It would be well that each presidency should have its own sanitary administration, its own health office, and its own agents for carrying out its own work. A proper sanitary system should include both troops and civil population ; there are many stations in such close relation with the civil populations, that unless you attend to the health of both you could not expect a good result. It is not possible to maintain our army in India in health if the population continues to be subject to the attacks of great epidemics. If the army is stationed among or near the native population, the army will be liable to the same attacks as the native population.

SPACE PER MAN IN BARRACKS. 5508.

The number of cubical feet to be given to each man in a tropical climate will depend upon the local position of the barrack. If the barrack is placed on very high ground, with the atmosphere playing freely about it, you can do with a smaller amount of cubic feet than in a low locality, where the circulation of the air is less perfect. Should say that for India the minimum should be 1,000 cubic feet of space, and 80 square feet of surface ; the maximum should be 1,500 cubic feet of space, and 100 square feet of area.

SPACE PER MAN IN HOSPITALS. 5509.

With regard to hospitals, our regulation for warm climates should be the minimum for India, that is 1,500 cubic feet, and the amount of cubic space per bed should lie between 1,500 and 2,000 cubic feet for India ; in the more exposed positions less, and in the closer positions more.

REGULATION OF BAZAARS. 5510, 5511.

It would be in the highest degree advisable to lay down as a rule that no buildings not under military administration should be allowed within a certain distance from a station. Should allow no native town to windward ; should send them to leeward. Before a bazaar is allowed to grow up, the military authorities should lay down a plan for streets and roads, and open spaces, as well as for all sanitary arrangements, water supply, drainage, latrines, &c.

DRAINAGE OF STATIONS. 5512, 5513.

Surface drainage of stations is attended to, but there is no other drainage, that is to say there is no subsoil drainage, and no drainage for removing the foul water from privies and urinals, or the water of washhouses or cookhouses, or anything of that kind. In very high and exposed stations, if you had a porous soil and a good fall for the

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IRREMOVABLE CAUSES OF DISEASE. 5517.

surface drainage, the same attention is not required to subsoil drainage as upon flat surfaces; but in all ordinary cases there should be no neglect of subsoil drainage merely because the climate happens to be dry, or the soil porous. A drained porous soil is practically the healthiest of all soils, but a porous soil, if undrained, is speedily saturated with decaying organic matter from the population on its surface, and becomes after a time one of the most unhealthy of soils.

With regard to what may be considered as the irremovable causes of disease, there is one general observation to make, namely, that the conditions of health at any one place are dependent upon the operation of all the causes at that place; and the true sanitary principle is to remove all those causes that are removable with the certain expectation that the constitution will be better able to withstand those that cannot be removed: so that if you cannot get rid of all the malaria, you will enable a man to stand against its effect, better by removing other causes that may predispose to disease.

W. Farr, M.D., F.R.S., D.C.L.

STATISTICS. 5532 to 5533.

WILLIAM FARR, M.D., F.R.S., D.C.L.

Was requested by this Commission to examine the returns in the Indian department, and to prepare a set of tables, which have been submitted to the Commission. We found a great deal of information in those returns; but on the whole it was exceedingly difficult to get precisely what we wanted; in consequence of which we applied to the Director-General of the Army, who was kind enough to request Dr. Balfour to endeavour to supply the information from the returns of the Queen's troops. Dr. Balfour has, in consequence, placed before the Commission a series of tables which are very valuable, but still they are defective, as they do not show the mortality at many of the stations for any considerable number of years. Would express strongly an opinion that the system of recording and analyzing the diseases of the army in England should be extended to India, where it appears likely to be more useful even than it is in England.

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CAUSES OF ARMY MORTALITY IN TROPICAL CLIMATES. 5534 to 5551.

Sir ALEXANDER MURRAY TULLOCH, K.C.B.

Has been engaged on inquiries into the vital and sanitary statistics of the army for a number of years; not only with regard to home service but with reference to the colonies. India was not included at the time the statistics of the troops in the colonies were published. Has examined into the causes of disease among troops resident in tropical climates, so far as the medical returns have afforded opportunity. The excess of the mortality in tropical climates has been very much over the mortality in the same class and at corresponding ages in temperate climates, particularly in the West Indies, the mortality there being about 8 per cent., and about 13 per cent. in Jamaica, instead of 1½, which is supposed to be the ordinary rate among troops in this country. A very considerable reduction in that mortality has been effected. In the West Indies it has been from 8 to 6 per cent., and in Jamaica from 13 to about 7 per cent. on the average of the 24 years subsequent to 1836. The chief causes of that great diminution in the mortality believes to have been the improvements after the year 1836, when the attention of the Government was first called to the enormous loss at these stations. These consisted of a larger issue of fresh instead of salt provisions; an increase in the barrack accommodation; in the frequency of the reliefs; in the attention paid to the comfort of the troops, and to their recreation and amusements. In Jamaica a change also took place by removing the troops to the high

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lands, where they were beyond the reach, or supposed to be beyond the reach, of malaria. Speaking from the experience acquired in these investigations, should say that one of the principal causes, at the present time, of disease and mortality in the army, especially in tropical climates is, that the cubic space allotted to each soldier is not sufficient. Another source of disease may arise from the want of sufficient variety in the soldiers' food by cooking it in different ways. Until very lately they had no change ; something between a soup and a stew was the only mode of dressing their meat. The erection of barracks upon high situations, instead of low, is a very important element ; but is aware that it cannot always be accomplished. With reference to other sources of disease within the tropics, is much disposed to regard idleness as one of them, and that our troops might be more healthy if they worked more there ; time hangs too heavily upon their hands. It has been found both in Martinique and Guadaloupe by the French Government that troops employed on fortifications during proper hours were more healthy than others. Of course, however, this requires to be done with great discretion, and under the strict superintendence of medical officers.

MEANS OF OCCUPATION. 5552 to 5554.

In tropical colonies there would be no difficulty whatever in constructing light, extensive, and covered buildings for workshops, because generally speaking the bamboo, from which you can form the posts, grows extensively there ; it will also supply a very light framework for the roofs, which being covered with leaves, you may at a very small expense get any shelter you require merely for the purpose of exercise or for workshops. Among other improvements, nothing appears more likely to be beneficial to the men than to have regimental gardens. The frequent removal of the troops from stations has prevented the system from being adopted to the extent that it might be in the West Indies. The gardens should belong to the station, and not to the regiment that happened to be quartered there at the time. The men generally are fond of gardening, and a very great proportion of them, after they are pensioned, become cultivators, and very successful ones, too.

RECRUITING. 5555 to 5557.

With regard to the age at which recruits enlist, if recruits be merely wanted for the ordinary purposes of drill, as in this country, it is desirable that they should enlist at the age of 18, but they should have two or three years' training in a temperate climate before they are exposed to a tropical climate, or to the fatigues of a compaign. Preliminary training can be best given at home. Wishes much, as part of that training, that it should be made obligatory upon all recruits to learn to read and write before being discharged from drill ; if it could be so arranged is confident that it would be a vast advantage to the army.

SOLDIERS' HABITS. 5558 to 5562.

The personal habits of the soldier have very much improved. There has been a very great improvement indeed of late years. As compared with the ordinary class of labouring men from which the soldier is taken, there is a want of power in the soldier to endure fatigue. It is a great evil that the soldier is not sufficiently trained to fatigue. Does not call it any great fatigue to shoulder a musket or march with a knapsack. The description of fatigue which he requires to be trained to is that which could readily be found for him in building fortifications or in erecting public works. The actual daily labour of the soldier is not sufficient to keep him in good physical training, at least in most regiments, but the drill of the recruits is made more severe to them than is necessary, considering that they have all their life to learn such details. The success of the volunteers shows that there is no necessity for this, and that a knowledge of the mere military duties of a soldier

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can be acquired in a comparatively short space of time without such over-work. The health of the soldier is undermined to some extent by venereal disease; but from all he can learn, doubts whether venereal disease is much more common in the army than in civil life; for instance, the ordinary proportion of venereal disease is somewhere about 120 cases among 1,000 men annually, at least it was so previously to the present year; out of these many arise from want of cleanliness; not more probably than 100 are really attributable to venereal disease, which is only equivalent to each man being under treatment once every 10 years.

MORTALITY IN INDIA. 5563.

Has examined the actual per-centage of mortality in India among British troops, and submits an annual Table of the mortality from all causes:

TABLE showing the Mortality in each of the Presidencies for a period of 39 years, extracted from the War Office Returns.

Year.	BENGAL.		MADRAS.		BOMBAY.	
	Strength.	Deaths.	Strength.	Deaths.	Strength.	Deaths.
1817	7,284	622	9,092	548	2,607	143
1818	6,203	384	9,306	903	3,645	352
1819	6,219	483	7,656	637	3,417	270
1820	6,156	439	7,043	411	3,076	404
1821	5,732	399	6,989	396	2,907	262
1822	5,899	365	6,949	491	3,164	318
1823	6,584	496	6,838	386	3,082	224
1824	6,894	937	7,388	1,068	2,562	147
1825	6,669	1,086	6,919	1,187	3,178	357
1826	7,877	1,312	6,405	1,081	2,936	344
1827	8,035	583	7,061	656	3,063	171
1828	8,284	633	7,602	434	3,222	209
1829	8,555	618	7,680	290	3,978	117
1830	8,325	406	7,408	219	3,914	160
1831	8,347	431	6,976	268	3,845	94
1832	8,031	346	6,773	418	3,723	79
1833	7,569	403	6,241	571	3,583	129
1834	7,340	394	6,086	444	3,426	134
1835	7,655	272	5,881	215	3,415	102
1836	7,541	369	6,646	254	3,465	139
1837	6,878	355	6,078	362	3,226	148
1838	5,401	327	5,493	269	3,319	141
1839	7,645	499	5,792	405	3,422	380
1840	8,581	1,268	6,255	265	4,402	296
1841	9,438	1,020	5,411	223	5,418	601
1842	12,593	1,698	6,101	292	6,106	668
1843	11,003	1,028	7,699	427	6,066	468
1844	11,280	984	7,850	276	6,323	824
1845	11,108	2,213	7,535	351	4,710	337
1846	11,007	1,103	5,772	264	7,197	681
1847	12,349	781	6,040	227	5,556	139
1848	11,502	1,190	5,321	125	6,208	179
1849	14,703	1,306	5,014	159	6,619	310
1850	17,307	911	4,838	110	5,872	165
1851	17,071	849	4,162	88	5,774	134
1852	16,659	1,196	4,548	304	5,688	194
1853	16,190	950	4,598	215	5,306	102
1854	17,087	782	4,357	143	4,104	90
1855	14,980	532	3,209	80	4,423	80
Totals	377,980	29,970	249,012	15,462	165,947	10,152

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SUMMARY of the foregoing.

	Strength.	Deaths.	Ratio per 1,000.
Bengal	377,980	29,970	79·2
Madras	249,012	15,462	62·9
Bombay	165,947	10,152	61·1
	792,939	55,584	70·0

Since the mutiny, has ascertained that the mortality, exclusive of casualties in the field, has been little more than half the above average. This is apparently attributable to the fact that many regiments returned home, bringing their broken-down men with them, who, if they had died in India, would have raised the death rate, and also that, during the mutiny, many new regiments were sent out to India.

MORTALITY AT INDIAN STATIONS. 5565.

The following are the results of an inquiry into the mortality of the stations :—

SUMMARY of Abstracts, showing the Sickness and Mortality of the Troops of the Line at the undermentioned Stations of the Indian Presidencies, between 1817 and 1836, and between 1838 and 1856.

BENGAL.

Stations.	Period of Observation.	Strength.	Admissions into Hospital.	Deaths.	Ratio per 1,000 of	
					Admissions.	Deaths.
	Yrs.					
Fort William	24	17,538	31,702	1,157	1,807	65·92
Chinsurah	9	5,014	9,165	284	1,827	56·64
Dinapore	22	17,760	34,409	1,387	1,937	78·09
Ghazeepore	19	13,938	22,526	725	1,616	52·01
Cawnpore	29	34,686	66,944	2,294	1,930	66·13
Agra	12	8,548	17,504	404	2,048	47·26
Meerut	33	41,840	60,471	1,501	1,445	35·87
Kurnaul	11	8,748	13,303	405	1,521	46·30
Hazareebaugh	4	2,422	4,018	114	1,659	47·07
Boglipore	4	2,564	4,338	224	1,691	87·36
Allahabad	2	938	2,325	108	2,479	115·14
Loodiana	2	1,251	2,826	159	2,259	127·10
Umballa	10	13,773	20,627	850	1,497	61·71
Kussowlie	7	5,040	6,160	247	1,222	49·01
Ferozepore	5	4,445	7,817	245	1,759	55·12
Jullundur	5	4,273	7,380	160	1,727	37·44
Lahore	7	5,232	14,901	473	2,848	90·40
Rawul Pindi	4	3,359	6,276	146	1,868	43·46
Peshawur	5	8,182	26,384	588	3,225	71·86
Wuzeerabad	4	6,889	11,436	408	1,660	59·22
Dugshai	3	2,618	3,726	69	1,423	26·36
Subathoo	3	935	1,524	29	1,630	31·02

MADRAS.

Fort St. George	34	25,464	46,813	1,014	1,838	39·82
Cannanore	35	28,225	43,234	908	1,531	32·17
Trichinopoly	30	22,945	41,993	918	1,829	40·00
Secunderabad	26	21,072	47,798	1,259	2,268	59·74
Bangalore	38	39,003	58,554	1,090	1,501	27·94
Bellary	17	12,794	25,170	612	1,959	47·8
Arnee	5	3,136	4,518	140	1,440	44·3
Kamptee	7	6,014	12,440	287	2,068	47·72
Tenasserim Provinces	9	9,165	16,218	302	1,770	33·00

BOMBAY.

Stations.	Period of Observation.	Strength.	Admissions into Hospital.	Deaths.	Ratio per 1,000 of	
					Admissions.	Deaths.
Colaba and Bombay	23	15,513	30,001	982	1,933	63·30
Poona	29	33,637	64,681	946	1,923	28·12
Belgaum	20	13,576	22,723	474	1,674	34·91
Deesa	11	10,155	15,141	394	1,491	38·80
Kirkee	24	15,338	26,665	396	1,738	25·82
Kairah	8	4,059	10,108	500	2,490	123·18
Kurrachee	12	12,410	23,662	585	1,907	47·14
Ahmednugger	3	1,154	2,765	66	2,396	57·19
Hyderabad	4	1,744	4,352	74	2,495	42·43
Aden	8	3,983	4,934	138	1,239	34·64

These results do not exhibit the loss at all the Indian stations during the first 39 years included in the table, but at those only where regiments have been stationed for the whole or the greater part of a year; they are also exclusive of the loss on long marches, which is often very heavy; but it has been considered more advisable thus to found the results on incomplete data, than to incur the risk of adopting what might prove to be incorrect.

DIFFICULTY OF SUPPLYING PRESENT LOSSES. 5568, 5569.

Assuming the present loss from disease at 60 per 1,000 per annum, and supposing the Indian army to be only 70,000 men, the loss would be 4,200. It might, perhaps, be reduced to about 1,400 men annually, but that is upon the supposition that you selected only healthy stations, and kept the troops there. You must always occupy some unhealthy stations; but supposing you kept 20,000 in unhealthy positions, the remaining 50,000 might be quartered in stations on the hills, or in localities known to be healthy. The loss there would be only about 2 per cent., or 1,000 annually; the loss on the remaining 20,000 at, say even 5 per cent., would be another 1,000; making a total loss of only 2,000 men a year, instead of 4,200. This country could, from what he knows of recruiting, be able to supply that number, and also to fill up the vacancies by invaliding, and the time expiring for which men had entered the service. But questions very much whether, during an active war, you could keep up 70,000 men in India, exposed to the mortality which has been usual during the last 40 years.

MORTALITY OF OFFICERS. 5583 to 5585.

The following table shows the mortality among officers in Bengal:

—	Colonels average Age 61.	Lieut.-Colonels, average Age 51.	Majors, average Age 40.	Captains, average Age 36.	Lieutenants, average Age 18 to 33.	Cornets and Ensigns, average Age 18 to 33.	General Average of all Ages.
Died annually per thousand of each rank	59·4	48·4	41·0	34·5	27·5	23·4	31·2

The mortality among the officers is about one half of that which takes place among the troops at corresponding ages. It would

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be a great advantage if arrangements were made by which soldiers who had frequently suffered from tropical disease in the East Indies, could be removed to regiments serving in colonies where that kind of disease did not exist, precisely in the same way as an officer who finds into that the climate of India does not suit his constitution, exchanges a regiment serving at the Cape of Good Hope, Australia, or America.

MORTALITY OF CIVILIANS. 5587 to 5595.

The following table gives the mortality amongst the civil service in the East Indies:

	Above 50 years of age and 30 of service.	Age 45 to 50, service 25 to 30.	Age 40 to 45, service 20 to 25.	Age 35 to 40, service 15 to 20.	Age 30 to 35, service 10 to 15.	Age 25 to 30, service 5 to 10.	Age 20 to 25, service 1 to 5.
Died annually per thousand of each class	48·6	36·4	35·4	23·4	16·6	20·8	19·9

The tables show that the mortality of Europeans in India need not exceed 2 per cent., if you selected healthy stations and found employment for the men in various ways, and if you had any means of increasing the proportion of European marriages.

HILL STATIONS. 5607 to 5610.

There is no reason, on military grounds, why a concentration of troops in healthy places should not be maintained, now that you are getting railroads laid down. It affords a further and very important consideration in this question, that unless some measures be introduced to lessen the mortality among the troops, the cost of transport to keep up the European army which it is contemplated to maintain in India will be enormous.

RELIEFS REQUIRED. 5612 to 5617.

With an army of 80,000 men, 8,000 would be required to relieve the regiments every 10 years, and 8,000 men would come home with their regiments, making 16,000 passages to be provided, besides those for 5,600 recruits who would be required to replace the men who died, calculating the deaths in 80,000 men at 70 per thousand. There would also be about 4,000 invalids and time-expired men, who had completed 10 years service, to be brought home; and about 4,000 recruits to go out to replace them. The average time occupied in the passage to India is about three months and a half, so that about 7,500 men would be constantly on the sea. The expense amounts to a very large sum indeed; so large that it would be between 250,000*l.* and 350,000*l.* annually, unless some means be adopted of selecting healthy stations, and so reducing the mortality; if you did so, a great part of these men to be relieved would like India, and would remain at those healthy stations, and not wish to come home at all; they would volunteer into other regiments, and in that way you would save the cost of transport. There would not be the same number of invalids, and probably a great part of the time-expired men would re-engage.

ACCLIMATIZATION. 5642 to 5643.

Rejects the doctrine of acclimatization *in toto*. Would certainly not attempt to found any sanitary measures upon it. Is happy to find that there is so great a change in the mortality of soldiers in this country, where great sanitary improvements have taken place.

BARRACK CONSTRUCTION. 5645 to 5650.

As regards healthiness of barracks, a very great advantage is likely to be obtained by having separate buildings for a limited number of men, instead of their all being in one barrack. It has often surprised

Sir A. M. Tulloch, K.C.B.

me that so much expense should be incurred, amounting, I believe, to about 80*l.* or 90*l.* a man,* in order to obtain enormous barracks, when soldiers would be much more likely to be healthy if in smaller buildings that would hold only 10 men each. All our exertions should be not to build enormous barracks, but to have small and inexpensive ones, in the erection of which, owing to their simplicity, the services of the soldiers might perhaps be made useful. A small cottage containing four rooms could be built for somewhere about 150*l.* If you were to put two men into each of those rooms, you would have accommodation for eight men for a sum which at 5 per cent. would be only 7*l.* 10*s.* a year. Has returns as to barracks which show the expense to be nearly five times that sum in this country, and has some from India which make it ten times as much. In India, thinks that the greater part of the buildings could be erected by the men.

Brewing Beer in India. 5650.

By locating men on hill stations in India, it may be possible for them to be supplied with beer to be manufactured there, and is afraid that if they are not so supplied, the enormous expense which is at present incurred in sending beer out to them from this country will ultimately have to be discontinued. Understands, from some returns, that the East Indian Government are paying now very nearly 200,000*l.* a year for the cost of supplying beer to the troops; there is no difficulty in brewing beer in India. Good hops and barley can be raised in the country, and a low equable temperature, such as is required for brewing, can be found at Bangalore, the Neilgherries, and various other places.

Dr. F. J. Mouat.

Dr. Frederic John Mouat, Surgeon Major, Bengal Army.

Condition of Native Lines. 5674 to 5702.

Has served about 21 years in India, in the presidency of Bengal; but also at Lahore, principally in the civil department. Has published several reports on the state of the jails in India. The native troops hut themselves, receiving some assistance to enable them to do so from the Government. The attempts which have been made to house them in barracks have been very unfavourably received by the native troops, partly on account of their caste prejudices, in some cases from having their families with them, but in almost all cases on account of the preference which the natives have for isolation and privacy—a home of their own. The huts are small; each man has his own hut, and if there are any members of his own immediate family with him, they live with him, but not otherwise. The huts are generally built of mud walls with grass roofs, or roofs covered with palm leaves; those built by Government are tiled, where tiles are procurable, from their incombustibility. There is very little interference by Government; in fact, the natives would not tolerate much interference. In the matter of interference, that of the officers appears to be confined to causing the huts to be built in regular lines, leaving a space between each, and the means of digging a trench for the purpose of drainage; but with regard to the interior of the hut, there is no supervision of any kind exercised; in fact, none would be submitted to by the great majority of the Sepoys; they will not allow you to approach within their bounds, or to come within their doors. The ground round about the huts is only drained by digging trenches. They are very dirty places, but people are employed by the cantonment officers to clean these places

* A summary recently prepared of the average cost of 10 barracks makes the rate 86*l.* 15*s.* for each man and officer quartered in them.

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and remove all the filth, but at the best of times the native lines are dirty; and if left to themselves they never would clean them; they would accumulate every possible species of filth there. There is no objection to the enforcement of external cleanliness, provided the interior of the houses is not interfered with. With regard to their personal habits of ablution, and what they term their *burri fudger*, and their defecations generally, in all such matters it is very difficult to deal with the habits of these people. The Hindoo Sepoy is particularly cleanly; cleanliness is one of the injunctions of his religion; but it is not so much so with the Mahomedan Sepoy and still less so with the Madras Sepoy, and the Mugh is probably the dirtiest of all in his lines. On parade and on duty great personal cleanliness is enforced.

WATER SUPPLY OF NATIVE LINES. 5703 to 5718.

Water for the native lines is invariably supplied from tanks in the Lower Provinces; in some of the up-country stations it is procured from deep wells, but almost always from tanks and wells combined, where there is good well water. There is generally a special tank set apart for bathing; but there is in every cantonment one large drinking tank which is popular among them, and contains purer water, and a guard is placed over that in order to prevent bathing, and to prevent dogs and animals being washed in it. In Lower Bengal water is very abundant always; the water is so near the surface that there the tanks are very rarely dry; in the Upper Provinces, at the dryest season of the year, the water is usually impure, and contain salts from the soil. For domestic use it is all conveyed by hand labour in goat skins. Water gets into the tanks from the rain fall, and partly from the drainage of the adjoining soil surface drainage; more rarely from springs in the soil. The surface water which drains into these tanks often conveys many impurities into them; after a heavy fall of rain the water is very muddy and dirty, and it takes 24 or 48 hours to subside and become clear. The old tanks, which were constructed by the Mahomedans, were lined with stone, but not those of the present day; they are simply excavated. In some places they are puddled with clay to prevent leakage, and there are generally brick steps constructed, ghauts as they are called, leading down to them. In Calcutta the tanks are frequently filled also from the neighbouring river. At every station which is unpopular among the natives, the diseases are ascribed first to the impure water, and next to bad air. That opinion is well founded. Worms and bowel affections are probably those most frequently caused by impure water. In a marshy district impure water has a tendency to produce diarrhœa, especially when, in a very dry season, the wells, and even the tank water, are more or less loaded with salts; and the same thing occurs from water that is drunk from tidal rivers. Accompanied a detachment of sailors to Assam during the mutiny, and the water was all taken in alongside from the river; a most frightful outbreak of cholera occurred within 24 hours after our embarkation, and the men attributed it to the water.

DISEASES OF NATIVE TROOPS. 5721–2.

The chief diseases which the natives are liable to are endemic and epidemic diseases, and no doubt those would be very much influenced by the quality of the water, and bad conservancy. In the epidemic outbreaks native troops suffer frightfully from cholera, fever, and dysentery.

DIET OF NATIVE TROOPS. 5726.

The diet of the Sepoy is entirely of his own choice; no influence is exercised over him in that matter, but the Government try to procure for him the largest quantity and best quality of the food to which he has been accustomed.

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NATIVE HUTTING. 5727-31.

Assuming that the hutting system must continue, if the huts were properly ventilated, built with greater regularity, with a sufficient amount of space, and if subsoil drainage were insisted upon as a practice, which it is not now, in addition to surface drainage, and the huts were made water-tight, their health and condition would be improved. The objection of the Sepoy to these things would be to the expense entirely; if he had to pay more for it he would object very forcibly, but if it were to be done at the same cost, he would not care about it. Every native in building his hut procures the earth used in raising the floor from a hole at the door, and this becomes the receptacle of all the refuse from his hut, so that any advantage that might result from raising the hut off the ground is counteracted by the filth which is deposited at its very door. The stench and effluvia are very great in native villages from this cause. They would not object to clear and level the ground, especially if the matter were simply explained to them, and that what was done was on purely sanitary grounds; any objection on their part would not be very strong if the Sepoy knew that as a condition of his service he must submit to these regulations, and if they were explained to him beforehand.

QUESTION OF CASTE. 5734-37.

A very great deal too much has been heretofore conceded on the score of caste, and many pleas of caste were admitted which were entirely erroneous. They will do anything for an officer who treats them kindly.

OCCUPATION OF NATIVE TROOPS. 5738-41.

The chief part of the Sepoys' time is occupied in lying on their backs upon their charpoys at the doors of their huts, smoking, and sleeping. They are fond of athletic exercises, and once or twice in a week they wrestle and play among themselves; they have a kind of native gymnasium in the lines of nearly every native regiment.

MORTALITY OF NATIVE TROOPS. 5743 to 5758.

The mortality amongst the native troops is returned at about 1·60 per cent., but it is not correct. The chief fallacy in that statement is that a man who has not served a sufficient length of time for a pension, if very sick, and if the sickness be of such a kind as to make it practicable to grant him leave, applies for leave to go home, and he goes home, where he dies from the effects of disease which he had contracted with his regiment; such a case is not brought into the mortality register. Rheumatism, the sequelæ of fevers, the effects of dysentery, and various internal organic affections, are the diseases which usually cause invaliding among native troops.

DRAINAGE OF NATIVE STATIONS. 5787 to 5788.

Natives use no latrines nor urinals; they are like the Israelites of old, they go and deposit their excreta on the plain, but they do not bury it as the Israelites did. A heavy shower of rain washes down all soluble matters through the natural percolation of the soil, and it must find its way to the tanks. Knows of no instance of natives using a latrine except in Fort William, and there they did it; but the latrine was placed over the Fort ditch, and it became a source of the utmost abomination. Was appointed a member of a committee to examine into the sanitary state of that Fort, and the ditch was most filthy; it was a reeking and abominable sewer for the deposit of all the fæcal matter of the garrison, and this ditch surrounded Fort William in every direction; but there they were obliged to go to the latrines, because the police would apprehend them, and they were punished if they went on to the plain. They likewise defecate when they go to bathe in the river, and pollute the water, although there is a strict rule among themselves that they are not to do so in the tanks in which they bathe.

MORTALITY IN PRISONS. 5792.

Last year the rate of mortality among the prisoners averaged 12 per cent., upon the average number who were in custody in Bengal.

Dr. G. C. Wallich.

Dr. GEORGE CHARLES WALLICH, Bengal Army, retired.

SANITARY CONDITION OF NATIVE LINES. 5812 to 5836.

Has served for nearly 17 years in Bengal, chiefly with native troops at Barrackpore, Berhampore, Ferozepore, Loodiana, Kurnaul, and Meerut, both in Lower Bengal and in the Upper Provinces, and at one station in Central India. Has had ample opportunities of observing the sanitary condition of the native troops. In the native lines the huts are very much huddled together, drainage is utterly disregarded; ventilation is not properly attended to; and, in the rains, from want of drainage much inconvenience must be felt. In many of the stations the Sepoys rather encourage the growth of jungle round their very doors. The jungle consists of high grass and bushes, which they plant. In laying out a native station the general outline to be occupied by native lines is marked out by the officers, but the rest is almost entirely left to the natives themselves. There are certain lines of road running between them for each company, but the arrangement of the huts is left very much to the men. These huts are very slenderly built, merely bamboo with matting. They are of no value; a hut does not cost above two rupees. The men sleep generally, except in the rains, outside. Objection to improvement ought not to be allowed. And in the same way with diet, when treating native troops medically, it is an absolute farce not to exercise some kind of control over their diet while they are sick. It would be possible to induce them to live in barracks. Hitherto they have not done it, because we have allowed them to do so much as they chose. They did not object to go, during an unhealthy season at Berhampore, into European barracks, indeed they were very glad to do it. Epidemics are not more liable to spread in barracks than in huts, if the ventilation is properly attended to; indeed, should think less so than in the low huts.

A great deal might be done in all our stations in the way of improving the condition of the native lines, both in the selection of localities and in drainage, and in the water supply; more especially, an improvement might be made in the quality of the water.

WATER SUPPLY. 5838 to 5859.

There are a great quantity of impurities in the water that comes from tanks. At Barrackpore one or two of the tanks were kept for drinking purposes; but during the rains, from percolation and the overflowing of the water, impurities are washed into the tanks. You cannot take up any portion of the mud that has been overflowed after the rains, without finding that on the surface it is one mass of minute plants and minute animals. The water is completely charged with organic matter, with the minute particles described. In one part of Berhampore the unhealthiness is so great that the Europeans will not live in it. One house has the name of fever hall, and. as certainly as anyone goes to live in it, he takes fever. Although the water appears to be perfectly clear all round the station, yet during the rains the country is inundated, and the whole of these minute particles are washed in, and the soil is left to dry up after the rains, which produces miasmata. Has known cases in which disease could be traced to the water, fevers, dysentery, and cholera. Would collect the rain water for use; this would prevent a great deal of disease in Bengal. The thing would be perfectly easy, because the rainfall is so great that a quantity might be collected quite sufficient for the largest garrison, and would store it away in covered iron tanks. There are plenty of open spaces to collect water in. A few miles of extent would be sufficient for the purpose. The water differs in character according to the soil; at Raneegunge, for instance, the water is very pure in certain places, where there is a hard irony soil, but, below in the hollows, where

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there is a great quantity of mould, the water is not so pure, and it is surcharged with minute particles of living vegetable matter. We know enough now of the effects of these elements to justify us in saying that the Government should incur considerable expense in supplying the troops with pure water. Cannot say absolutely that these minute matters produce diseases, but we are justified in inferring that they do, in the absence of any other known cause; we talk of malaria, but we do not know what it is. Most of the scums and films resting on stagnant waters and damp surfaces generally all over the world are actually derived from minute living plants, they go on propagating. Thinks it very probable that under certain conditions, of which we know nothing now, these same little organisms affect the human body, while at other times they would not affect it. The habits of the natives must necessarily cause the water in the tanks to become impure, in point of fact the natives have no idea of taking sanitary precautions. For instance, a man will eat and drink and perform his evacuations actually on the very same foot of water, standing in it, or close to it; he has no idea of impurity as long as it happens to be Ganges water. The European troops and also the native troops drink the water from these tanks; there is nothing else for them, and the same causes will operate with Europeans in an increased degree. Filtering water upon a sufficiently large scale would be more costly than storing up rain water. At Barrackpore there is no other water but that which is taken from the tanks; it is pure looking water that you get from one particular tank; it is clean, but it is nevertheless full of living vegetable matter. Continued boiling would perhaps be the greatest safeguard; but many of those lower organisms will stand an immense amount of heat, and then when they are placed under circumstances which are favourable to germination they will grow again.

CAUSES OF DISEASE AND MORTALITY. 5860 to 5863.

Thinks that the climate, the water, and the peculiar mode of life taken together, are sufficient to account for the great rate of mortality among Europeans. The diseases which chiefly prevail among the natives are dysentery, fevers, cholera, and rheumatism; the three first are the chief fatal diseases, and these, he thinks, will eventually be traced to impurities in the water.

SANITARY IMPROVEMENTS FOR NATIVES. 5879 to 5900.

The most likely way of diminishing diseases which are prevalent among the native troops would be great care in the selection of cantonments, proper attention to ventilation and drainage, and some limitation as to diet. When the men are maintained in hospital at a great expense to the Government, besides the loss of their services, they are getting medicine from the surgeon, whilst they are at the same time completely at liberty to adopt any diet which they choose. Government allows a sick man to be supplied with expensive drugs, but gives no control over his diet. There is no control over their huts. It is the duty of the medical man to report what he sees; but, unless the officer commanding the station has some funds at his disposal for the purpose of effecting alterations, it is no use; the reports cannot be attended to. There is no power whatever of preventing disease. When the services of the men are purchased at a very high rate, the Government are perfectly justified in exacting those services to the greatest possible extent, where you do not do a man harm or wound his religious feelings. Does not think that a man would object to measures of sanitary precaution, for instance, living in barracks, or a particular limitation as to diet, if he knew that the Government was determined not to employ men who would object to being so treated. The worst evils in the native lines are the impure quality of the water;

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that the lines are badly arranged; that there is a great want of drainage and also a want of ventilation.

SANITARY MEASURES FOR EUROPEANS. 5901 to 5921.

A good deal might be done to improve the condition of the European troops in India by preventive measures, such as giving them quinine, when they are still in barracks or not actually in hospital. Also by having inspections so that when the medical officer thinks that a man is likely to become sick he should use preventive measures. Diseases, such as fever, cholera, and dysentery, do not attack a man unless he is in a particular condition of body,—unless he is already out of order. A great many precautions might be taken in India to prevent disease by treating men before they are actually attacked by it. That could be done by more careful inspections of European troops, for you constantly see men who have been for a long time looking unhealthy, flaccid, and pale, but they do not come into hospital, and those are the men who have these attacks. By giving one or two doses of ordinary medicine you may frequently prevent a man from being attacked by disease, or when his system is out of tone by giving him quinine, which is one of the most valuable preventives that can be used in India, not only as against the one or two specific diseases, but against other diseases. This is in the power of the medical officer of a regiment now, but it is not done; in the first place, quinine is a very expensive medicine, and a man cannot step out of his way to do what no one else has done. A man is sometimes for weeks and months not well; he loses his appetite, he feels listless and heavy, and he gets an attack of disease, which he probably would not have if his symptoms were earlier attended to, and he was treated as suggested. Has seen most serious outbreaks of cholera. A healthy man is not generally attacked with cholera, it is, generally speaking, the man who is out of sorts, and suffering from slight diarrhœa, which merges into cholera. In cholera the only cases that are cured are those which are treated in the early stage. This is not often done. The men have not an opportunity of coming in; they come into the hospital after the first stage, which is often extremely short, and cholera cannot be treated successfully except in the first stage, it is so rapid.

Serjeant-Major W. Walker.

Sergeant-Major WILLIAM WALKER, 1st Battalion, 8th Regiment.

RATIONS. 5923 to 5934.

Has served in India 20 years, in the Bombay and Bengal presidencies, and also at Aden. The soldier in India is better fed than in England. There is variety in their food. They get roast, boiled, and baked, and altogether the different rations are far superior to what they get in England; not in the quality of the food, but every soldier in England must confine himself, at the most, to two descriptions of food, either boiled or baked meat; but in India every soldier can order his own dinner; he has the choice of 20 different dinners; there has been a great improvement made in the diet, especially with regard to the bread, which, on his first going to India, was of a very inferior description to what it was afterwards. Vegetables are much the same as they were, but the potato, a dainty 20 years ago in India, is now served out to a regiment in plenty. During the last 12 years in India the soldier has been liberally supplied with vegetables.

DRINK. 5937 to 5945.

With regard to the supply of liquor to the soldier, beer is abundantly supplied to him, and of the best quality. It is only 3*d.* a quart, but the Government is at a certain loss by the sale of it. If commanding officers of regiments did not take means to prevent even beer from being adulterated, there might be complaints made by the men.

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There is a non-commissioned officer who receives 5*l.* a month from the Government, in addition to his pay, to look after the canteen; of course, if he is dishonest, (there is roguery in all trades,) and if they are not looked after, there are means of doing such a thing.

INTEMPERANCE. 5947 to 5978.

If a soldier draws beer he is only allowed to draw one dram (speaking of the Bengal dram, there are 40 to a gallon); the liquor is made in one of the Government factories, and is of the best quality. He is not allowed to draw it until after 12 o'clock in the day. Should a man think proper to drink his quart of beer he is allowed one dram of spirits and no more. He drinks it at the table in the canteen—he must have a pass from his commanding officer to take away one dram from the canteen, and if liquor is found in the possession of any soldier in India without a written pass from his commanding officer, he is immediately placed in confinement and called to account for it, neither is a civilian allowed to sell liquor to any soldier without a written authority from the officer commanding the station in which the civilian resides. In the case of a man not consuming beer, he may have two drams, one after 12 o'clock in the day and one at night. There are instances in which liquor is smuggled in, and that is of the worst description; it kills many soldiers. Formerly there were a considerable number of men who obtained smuggled liquor, but recently the military police have been brought to such perfection that it is almost impossible to smuggle a single glass of liquor into a station. The grog shops outside of the cantonments are solely for the use of the natives; if a European soldier enters one of them he is immediately made a prisoner, and if a native is seen to sell one drop of grog or to give one drop of grog to a soldier, he becomes immediately liable to a heavy penalty; one that would ruin him for a year. There is plenty of drunkenness every day in every regiment in India; they obtain the liquor in the canteens through great neglect on the part of the non-commissioned officers. In the hot season of the year the soldiers are not allowed to go near the canteens until sun-down; they are confined to the barrack room during that season, which lasts from about the month of May until October; during that time they are strictly confined to the barracks during mid-day, and a non-commissioned officer will go round to each company and collect the names of the men who require beer for their dinner; a man may put himself down for a quart of beer, and the money is collected at the same time from the men and handed over to the non-commissioned officer; he then goes with a written pass signed by the senior non-commissioned officer of the company to the canteen sergeant, draws the liquor, and brings it up to the barrack, and issues it to the men at the dinner hour; there may be men who get drunk in that way, because a man is allowed to take his quart away, and place it on the table and drink it with his dinner, and he may give his comrade a drink. The price of a dram of spirits is one anna. A great number of the punishments of the soldiers are incurred for crimes committed in a state of intemperance. But crime has diminished in India, more so than in England; there are fewer prisoners in India. The men, is sure, would object to being deprived of the use of spirits as a general thing. They generally prefer a glass of spirits on certain occasions, during the campaigns, and they require a stimulant of some kind after a long and fatiguing march, and during hard work. If they were convinced that spirits were injurious to their health, and did them, upon the whole, harm, they would not object to the substitution of other drinks. Even sober men like to have the choice of getting a dram of spirits occasionally. Thinks that it would be a good thing if meetings were held, at which the soldiers were

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invited to attend, and where the medical gentlemen would point out to them, in a plain manner, the errors arising from drinking in India, and give the soldiers a lucid explanation of the injurious consequences. That would be better than all the general orders that might be issued; the men generally might not go at first, but some few might go, and they would tell their comrades, and so it would pass on from one to another, and that would be a very good way of bringing the men to consider their own safety, and of abstaining, to a certain extent, from drinking spirits.

DRESS. 5995 to 6006.

The ammunition boot is the best for India. It protects the foot from the burning soil; the soles are stronger than the native boots, and protect the feet, and in the wet season they keep out more wet than the Indian leather; the Indian shoes wear out in no time on the macadamized roads in India. The best head-dress was one that we used in Colonel Greathed's brigade,—going down from Delhi to Cawnpore—a plain forage cap, the Kilmarnock—with a padded calico cover over it, and a turban fastened round it; it was sword proof, and you could make a pillow of it. It had a flap behind, which covered the back of the head from the sun, and itwas light and comfortable; it fitted the head and sat easily. If you were on picket and wished to lie down, it formed a pillow of itself. The stock has been discontinued in India altogether, except when parading in full dress clothing twice a year for general inspection.

HILL STATIONS. 6014 to 6017.

Never has been quartered at a hill station. Soldiers like the hill stations; and a great thing it would be in Bengal if they could only mass the main body of the troops in the hot weather at the different stations in the hills, letting the regiments take their turn about for duty in the plains, in the strongest forts and places about, and let the native troops do the remainder of their work. It would be the best thing that ever was done; for the men, during the hot weather in the plains, cannot sleep at night from the heat; they have no energy about them, and they go and get drink to put a little life into them; and they would not want it at the hills.

CONFINEMENT TO BARRACKS. 6019 to 6025.

The men find confinement to the barracks in hot weather very irksome; they would rather be out in the sun; and some men might be out in the sun for years and years and never become sick, but upon others who go out in the sun, it would take an effect upon them. The following is the daily life of the soldier when quartered on the plains in India. He must be up 20 minutes after gun-fire; but the time varies, sometimes at four o'clock, and sometimes at five o'clock, in hot weather, say half-past four. He must be up at five, as the parade is generally at half-past five or a quarter to six, and the parade must be over shortly after sunrise, a quarter past seven. Then there is breakfast; after breakfast he amuses himself in the barrack room. Then there is a parade at half-past ten in side arms in the barrack room; then he cleans his accoutrements; after that he has his dinner. He can go to bed if he likes; that is, he must not go into bed, but he can lie on it; the bed is made up. Then the afternoon parade takes place; then he has his supper, and after that he has nothing to do until the tattoo beats at eight or nine o'clock, as the case may be. In the hot season he must stop within the barrack between eight in the morning and four in the afternoon; if he is caught out of barracks he is liable to be confined, except he is on duty. While confined to barracks some of them read, some go to sleep, some play at dominos, but they are not allowed to gamble; cards are never allowed, but they may play at dominos, or chess, and backgammon. During the rainy season there is very little change. The

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men cannot go out. It is exactly the same ; but the parade cannot be outside. There are three parades per day, and, as they cannot be outside, they have them inside the barrack. In the evening almost all the men stroll round the barrack in some way.

MEANS OF OCCUPATION. 6028 to 6054.

They are very comfortable in the cold weather. They commence with drilling in the morning ; there is none in the middle of the day, no matter whether it is the cold or the hot season. They are generally drilled in the evening again, say after four o'clock in the cold weather, and the men then have plenty of amusement, cricket, and other games ; but there is one thing that would be very good for them in the stations, and that is to have more plunge baths for the men. It is a bad thing not to have them. There should be one close to each wing of a barrack, so that a man could go in hot weather under cover to these plunge baths. There is nothing that the soldier likes so much in India as a plunge bath. If soldiers in India were encouraged to work at their own trades as they do at Aldershot, it would be a good thing ; the soldiers there do the whole of the work, and there are carpenters and stone masons, and they do it all themselves under a new regulation there in camp, and they take a pleasure in it ; it is a variation they consider to their daily life, and it would be the same in India. They would take a pleasure in it, and there is nothing in India that tends so much to keep the soldier in health as to keep his mind employed ; if he is allowed to lounge about and to lie down, almost any man will get sick there. Has never seen any means supplied to regiments for athletic exercises nor exercising grounds, nothing but the skittle alley and cricket ; it was on their own parade ground that they exercised themselves at that. We had several men who were gardeners, and we let them off duty for the purpose of attending to this garden ; any man was allowed to walk in the garden as long as the things were not interfered with ; and the commanding officer visited it, and made every inquiry, and saw that they had proper seed placed in it ; we used to get a certain quantity of vegetables from the garden, in addition to what we received from the commissariat, and vegetables of the best description.

CAUSES OF DISEASE. 6104 to 6142.

The great cause of sickness in India is the bad drainage about the barracks, and the filth of the towns that the barracks are near. Troops fresh from home always stand disease better ; they always seem stronger and better able to withstand those sort of things ; the longer a soldier has been in India, the less he is able to stand attacks of sickness. In many instances the barracks are not sufficiently high and ventilated for the number of men that they contain at some of the stations ; at others, and indeed, at almost all the stations, there is no such thing as proper drainage, no sewers. At the corner of each barrack room there is what they call a cesspool, where all the filthy water, soap suds, and all sorts of dirty water runs in ; it is ladled out by the natives at certain hours in the day or night when full, and sometimes there is a fearful smell from it in the hot weather, the sun being upon it ; it almost stifles you. Is certain it is injurious ; there is a bad smell even in the washhouses, although they are kept clean. The sleeping rooms in the barracks at night during the hot weather are very close, and there is a very bad smell, which any one can perceive that comes in from the air. If you go into a barrack room, there is a very bad smell. The worst water that a soldier has in India is in Calcutta ; it is not fit to use ; indeed, it is dangerous. Is sure that there are more soldiers die in Calcutta than in any other station in Bengal ; and is certain that most of them die from the frightfully bad water that they get there ; men who do

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not take the trouble to purify it with alum and charcoal frequently become sick. The closets and urinals in India are emptied every night; they are supposed to be emptied before gun-fire in the morning; before the soldier wakes, everything is supposed to be cleared away, and that is almost always the case; sometimes it may be neglected, and in such instances the people who ought to have done it are punished by the quartermaster. The native nurses in hospitals are not so attentive as the European orderlies. With regard to the wounded, the soldiers have almost all comrades for that purpose, they send for them from the regiment; but they do not let the natives meddle with them, except to bring them their food. If a man is very ill there is always a man belonging to his company who is sent to the hospital to superintend the natives in what they have got to do. The soldier is well treated in hospital. For those who are able to wash themselves there is a wash-house; for those who are not able to go outside they generally wash near the cot, and there are proper chatties, as they call them, to wash in, and the natives carry them away, and throw the water away into the cesspool.

HOSPITALS. 6143 to 6147.

WANT OF DRAINAGE. 9147.

Drainage is the principal thing that is wanted. Is certain that the barracks in India, even in the plains of Bengal, could be made a great deal more healthy, provided they were properly drained, for after the rains there will be a pool of water standing in the lines for five or six days; that gradually dries up by the heat of the sun, but there is much smell from it, and it must cause fever; these things are often reported by the men and by the officers. Has always noticed that the sick list takes one particular barrack room more than another, or one particular side of a barrack more so than it does another; from what cause cannot say, but there is always more sickness in the rains than during any other period of the year in India.

BARRACK FLOORS. 6149 to 6152.

The best floors for a barrack are a kind of freestone in large slabs; the floors in the Bombay presidency are chiefly of earth, with cow dung put over once a week by the hands of the natives, and left to dry. The men do not like those floors. The principal reason is the dirt that is occasioned, and the trouble that it gives them, for the soldier cannot move about in his barrack room until it gets dry, and it takes a considerable time to get the cow dung dry, and of course it smells.

OBSERVATIONS BY MISS NIGHTINGALE ON THE STATIONAL REPORTS.

My Lord,

In compliance with the request sent to me by the Royal Commission on the Sanitary State of the Army in India, in a letter of 11th October 1861, that I would make on the contents of certain MS. replies to printed queries addressed to all Indian military stations any observations which might occur to me as bearing on the sanitary condition of cantonments and hospitals, I beg to transmit the following. In doing this, the difficulty of giving what every one might consider a fair representation of questions of such extent, by stating specific cases, has been great. Some will see no importance to health in the facts. Some will think the facts given the exception and not the rule. If there be an exception, *i.e.*, if there be a single station in India with a good system of drainage, water supply, and cleansing for itself and its bazaars, with properly planned and constructed barracks and hospitals, provided with what is necessary for occupation and health—a station where the men are not encouraged to drink, and where they are provided with rational means for employing their time—to such a station these remarks do not apply. But I have not found it. Everywhere there are grievous sanitary defects, which, wherever they exist, can lead only to sickness and loss of life to the degree in which they exist. And let those who doubt whether this representation is true, taken as a whole, look at the stational reports for themselves.

In the papers sent me I find an amount of evidence showing the causes of disease in the Indian army, such as perhaps was never before brought together on any similar subject. It is shown in these papers that :—

I. Indian Stations are subject to the Diseases of Camps.

The prevailing diseases at Indian stations are zymotic diseases, connected with camps,—such as I myself have seen,—all of them, cholera, fevers, diarrhœa, dysentery ; together with hepatic disease.

The main point of the Indian sanitary question is, indeed, camp disease, the causes of which are rendered more intense by climate ; and liver disease, occasioned to a great extent by over-eating and over-drinking, and sedentary habits, the result of these habits being, as in the former case, intensified by climate.

Stations have been chosen with as little regard to health as camps often have been. Many are in positions which the mere verbal description proves to be unsuitable. Or, at all events, little or nothing appears to have been done to render them suitable. They are low, damp, or even wet, often mixed up with unhealthy native towns and bazaars abounding with nuisances.

II. Indian Stations present the same Sanitary Defects as Camps.

At all or nearly all the stations the usual causes of camp disease appear to exist. I will give examples of the more important of these as shortly as I can, as they exist at the larger British stations. These are :—

(1.) Bad water.
(2.) Bad drainage.
(3.) Filthy bazaars.
(4.) Want of ventilation.
(5.) Surface overcrowding in barrack huts and sick wards.

(1.) *Bad Water.*

Hyderabad (in Scinde) says, "No doubt it (the water) *swarms* with "animal life."

Where tests have been used, the composition of the water reads like a very intricate prescription, containing nearly all the chlorides, sulphates, nitrates, and carbonates in the pharmacopœia, besides silica and large quantities of organic matter (animal and vegetable), which the reports apparently suppose to be nutritive, for few of them but "consider" the water "good" and "wholesome;" *e.g.* Fort William, Calcutta, says that the water for cooking, drinking, &c., is carried from a tank *filled by surface drainage*, which tank is kept "perfectly clean." and is "generally free" from "surface impurities." Many "*city* tanks "are in a most filthy condition, producing malaria." Sealkote calls its water "decidedly good," while containing a considerable portion of sulphate of lime. Ghazeepore calls its water "good and sweet," and says that it "does not seem contaminated by the amount of "leaves that necessarily fall into open structures." Chunar says that its water is clear, sweet, and inodorous "if allowed to settle "before it is drunk." Agra's water is "laxative," and "apt to disagree "*at first*." Dinapore admits that its wells have been poisoned by infiltration from barrack privies. Nusseerabad says, "the flavour (of the "water) varies according to the quantity of the salts." At Murree the quality is "considered inferior by native visitors, and to cause colic." "Boiling" and filtration through sand and charcoal are necessary to "render it wholesome." At Hazareebaugh tank water "on standing, "copiously deposits," and contains "organic matter in considerable "quantity." Its well water for domestic use contains silicic, phosphoric, hydrochloric, and carbonic acids. But it is satisfactory to know that "persons *particular* about the quality of their drinking water" can "obtain their supply" from "several good wells."

At Bangalore, the Ulsoor tank, used for drinking, is the outlet for the whole drainage of a most filthy bazaar (125,000 inhabitants), for that of our cavalry, infantry, and horse artillery barracks, and of the greater proportion of the station. The commander-in-chief says, "the "disgustingly filthy nature of the source, from which the water used "at Bangalore is taken, has been brought to notice scores of times by "me within the last 4½ years; but, as usual, nothing has been done "to remedy this most crying evil." Even the wells from which drinking water is taken are impure from sewage. They are open; and "when they get dirty are cleaned."

At Secunderabad as much as 119 grs. of solid matter, and, as it would appear, 30 grs. of organic matter per gallon, are found in some

of the well and tank water. [Secunderabad and Poona are almost the only stations which give a chemical analysis.]

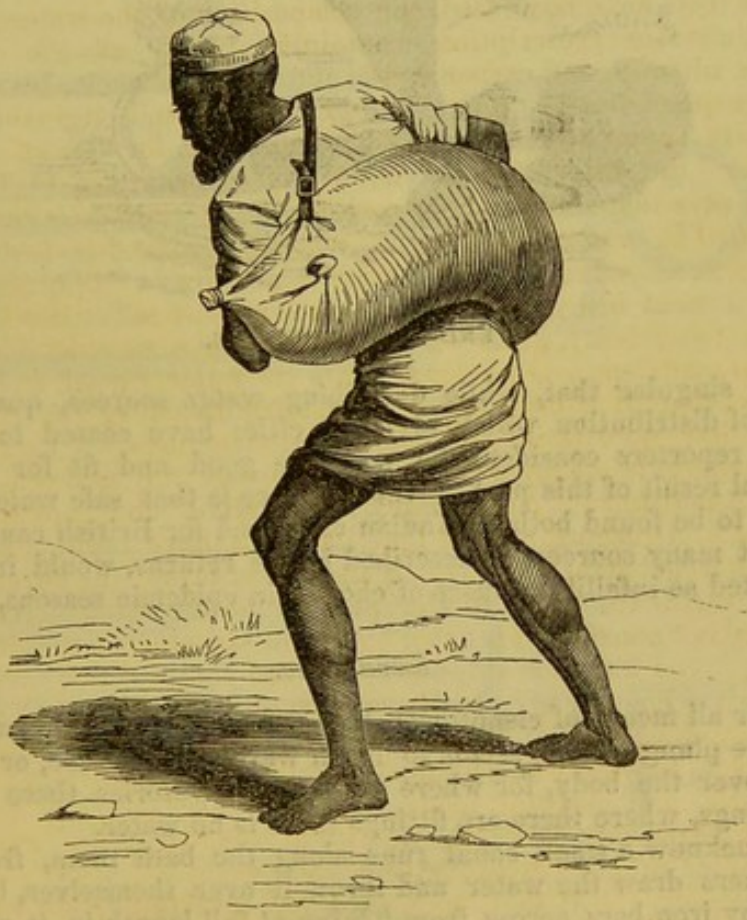
At Surat "no one thinks of drinking the camp water."

At Asseerghur the same tank is used for drinking and bathing. "For the former the natives slightly clear away the surface." Asseerghur thinks that its water "*smells* good."

The application of chemical science to water supply appears hardly to be in its infancy in India.

The arrangements for raising and distributing water are everywhere, as Bombay Presidency remarks, the same as what they might have been "1,000 years or more ago." Belgaum has attained the maximum of civilization under this antique system. The water is there "raised "in leather skins by bullocks, emptied into troughs, and thence con- "veyed by water carriers."

At Kirkee "no such a thing as a pump is known;" Government pays 617 rupees per (hot) month to water carriers.



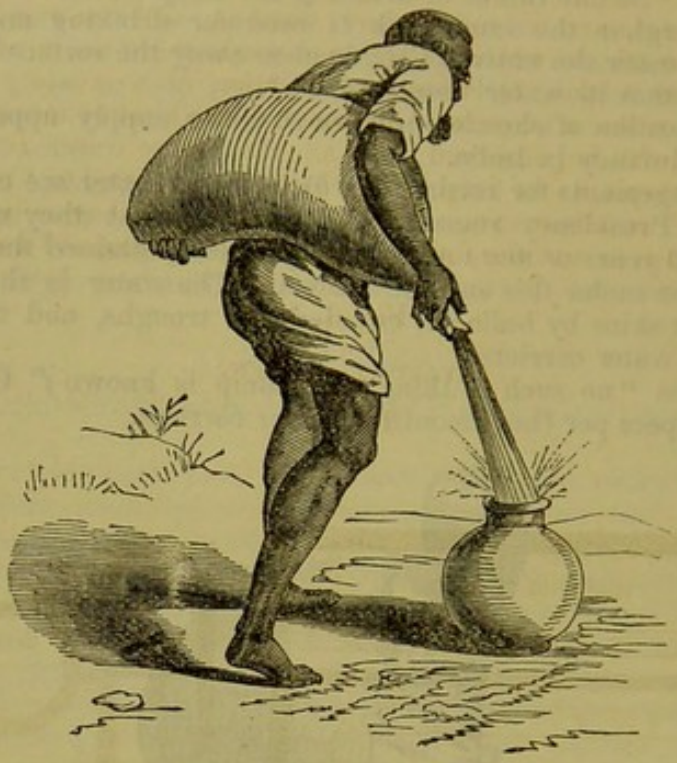
BEGINNING OF WATER PIPE.*

Everywhere "each individual has his bheestie, and each regiment "its set of bheesties."

These water pipes with a will are not always found to answer, for Fort William (which pays them 134*l.* per annum) admits that they

* Words convey such an imperfect idea of the actual state of things, that I obtained, by the great kindness of an Indian friend, illustrations taken from the life, which I have had cut in wood and transmit with this paper. I have also had woodcuts prepared of barrack and hospital plans, from drawings contained in the paper sent me.

sometimes take the water from "nearer and impurer sources." Would it not be better to try water-pipes without a will ?*



END OF WATER PIPE.

It is singular that, while describing water sources, qualities, and modes of distribution which civilized cities have ceased to use, most of the reporters consider the water as good and fit for use. The practical result of this part of the evidence is that safe water supplies are yet to be found both for Indian cities and for British cantonments ; and that many sources, as described in the returns, would in England be scouted as infallible causes of cholera in epidemic seasons.

Lavatories.

As for all means of cleanliness, bathing, except in a few cases where there are plunge baths, seems to mean washing the face, or throwing water over the body, for where there are lavatories there are no or few fittings, where there are fittings there is no water.

At Lucknow a small canal runs along the bath room, from which the bathers draw the water and throw it over themselves, being prevented by iron bars across from "lying at full length in it and soiling "the whole supply." The bath at Meean Meer is a long shallow tank, "in which the man can lie down and bathe."

* The reason usually assigned for employing these human water-pipes in barracks is, that they are indispensable on field service. But so are tents ; and yet nobody proposes to barrack men in tents in time of peace. Barracks are built for peace, and ought to be supplied with reasonable and decent conveniences. Why should the bheestie and waterskin be preserved when the tent is abandoned ? Let the bheestie be for field service, if no better device can be discovered ; but let some civilised method be adopted of supplying barracks, garrisons, and towns with this prime element of health and cleanliness. Besides, human labour is daily becoming of higher value in India, and it may be actually more expensive to use men as beasts of burden now than to use the appliances of civilization.

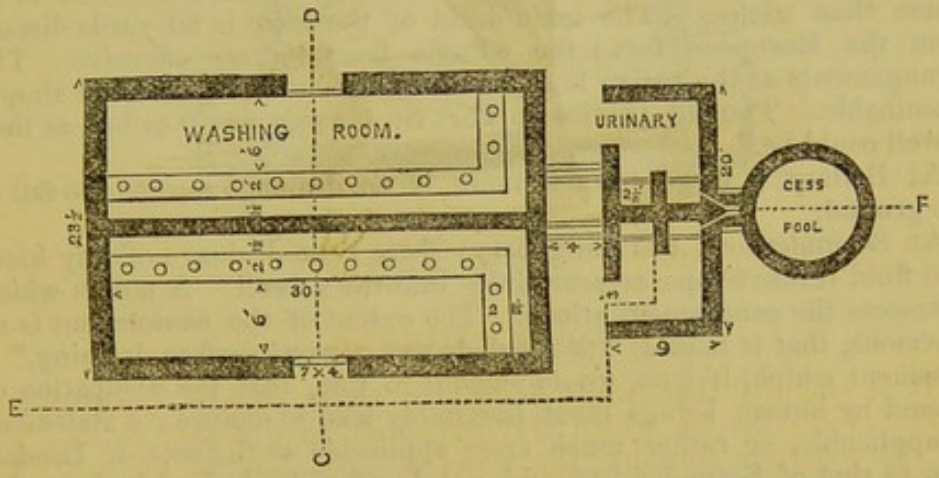
Madras and Wellington are literally the only stations where anything like lavatories and baths, with proper laying on of water and proper draining it off, is known either in barrack or hospital. But at St. Thomas' Mount, and at many other stations, each lavatory is a tub filled by a bheestie, in which all the men wash, there being no basins.

Fig. 1 gives a plan, elevation, and section of a lavatory at Aden, which affords rather a favourable specimen of the kind of accommodation provided. It will be observed that all the refuse water is conveyed into a built cesspit, 8 feet deep, from which it is expected to "make away "with itself," as it best can. Why cannot civilized basins be provided for men to wash in and the foul water be properly drained away?

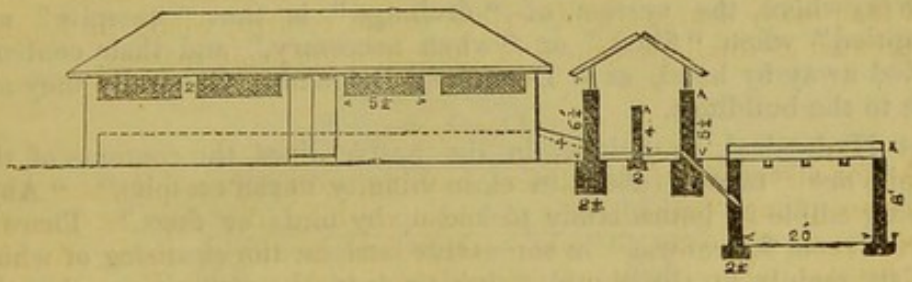
Fig. 1.

LAVATORY. ADEN.

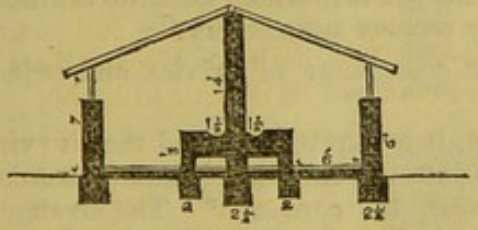
Plan.



Longitudinal Section.



Section on C.D.



Washing and bathing in barracks and hospitals will have to be conducted on quite a different scale from the present in India, if health and cleanliness are aimed at. If the facilities for washing were as great as those for drink, our Indian army would be the cleanest body of men in the world.

(2.) *Bad Drainage.*

This may be rendered NO drainage whatever, in any sense in which we understand drainage. The reports speak of cesspits as if they were dressing rooms. As at Nusseerabad and Kolapore, "a small cesspit is "attached to each bathing room, urinal, or privy," and "to each "married man's quarter there is a bathing room with cesspit."

At the capital of the Bombay Presidency, where civilisation has introduced a "main drain" 2 feet square, with a "flat bottom," this "main drain" is a "great nuisance," and the "stench at times scarcely "to be endured." At Fort George, in Bombay, the "latrines are not "drained except into an open ditch, which is always in a foul state."

Indeed, Bombay would gladly say, as the London woman said when asked to point out the drains, in the days when London drainage was in a similar state, "No, thank God, sir, we have none of them foul "stinking things here."

At Madras (Fort St. George) the drainage hitherto is stated to be worse than useless. The main drain of the town is 80 yards distant from the European fort; the effluvia from it very offensive. The arrangements at the native lines, as described in the reports, are simply abominable. The old privies in Fort St. George are "as bad as they "well could be."

At Bellary, a large station, there is no drainage except the fall of the ground.

At Secunderabad (Trimulgherry) there is no drainage of any kind. The fluid refuse evaporates or sinks into the subsoil. A nullah which intersects the cantonment stinks. The extent of the cantonment is so enormous, that it is said "to preclude any general surface draining," a statement which, if true, would amount to this, that the occupation of ground by human beings must inevitably lead to disease; a statement as applicable, or rather much more applicable to the area of London than to that of Secunderabad, and yet London is drained both on the surface and below it.

Everywhere the system of "drainage" is that "cesspits" are "emptied" when "filled," or "when necessary," and their contents carried away by hand, as at Deesa and Belgaum. Generally they are close to the buildings.

At Hyderabad, in Scinde, in the native lines, the contents of the cesspits are "thrown about in close vicinity to the cesspits." "Any-"thing edible is immediately picked up by birds or dogs." There is "great room for reform" in the native latrines, the cleansing of which consists mainly in the liquid "sinking into the subsoil, so that the "earth is thoroughly saturated, and a *noisome odour pervades* the "atmosphere." And yet it is added that the sanitary condition of the station is "in every respect satisfactory."

At Neemuch the "drainage of privies and urinals is only on the "surface."

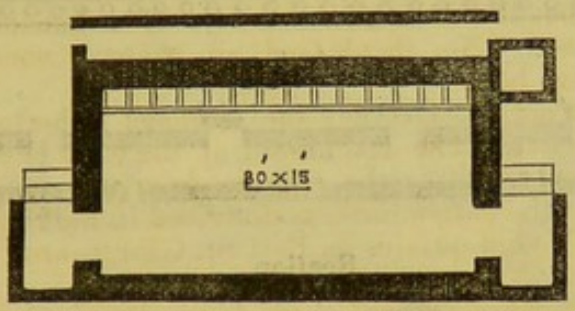
Often, as at Aden, it is expressly stated that it (viz. "all drainage") is "allowed to sink into the subsoil," which (at Aden) we are told is so useful as to "absorb the contents." The arrangement for enabling it to do this is shown in Fig. 1. Figs. 2 and 3 represent the usual construction of latrines. In Fig. 2 the contents are intended to be swept up and removed daily by hand,—a noisome and dangerous process, especially during epidemics. Fig. 3 shows the cesspool system of "cleansing," which means saturating the subsoil with filth, and endangering all the wells in the neighbourhood.

At Neemuch, which has attained the high pitch of civilisation of building latrines for its bazaar, the "latrines are too close to the houses, "and are not used at present, *for lack of a proper establishment to "keep them clean.*" Therefore the people at Neemuch do like their neighbours in this respect, a proceeding which it is impossible to describe farther. At Asseerghur a similar abomination appears to be practised on an "open space of ground near the main guard and "parade," which is "always offensive," and "ready to nurture epi-"demic disease."

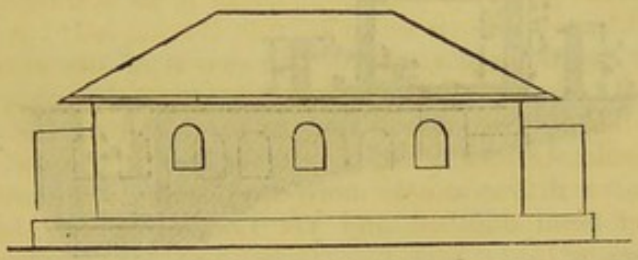
Fig. 2.

LATRINE. POONA.

Plan.



Elevation.



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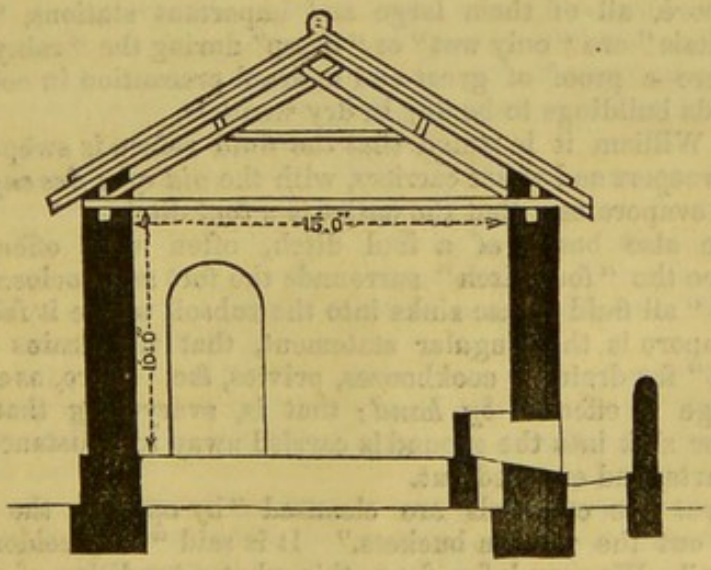
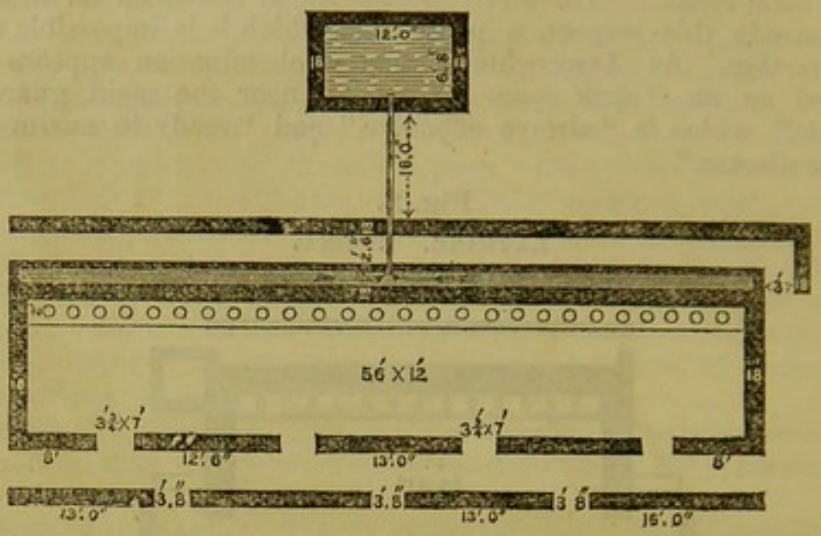


At Asseerghur the "construction of sewers and drains has not as yet "been considered." They "consider," on the contrary, that the sewage "will probably be removed by hand." The refuse, in all cases, is thrown "over the fort wall." "One of the tanks" is called "un-"savoury."

Fig. 3.

INFANTRY BARRACKS LATRINE. BELGAUM.

Plan.



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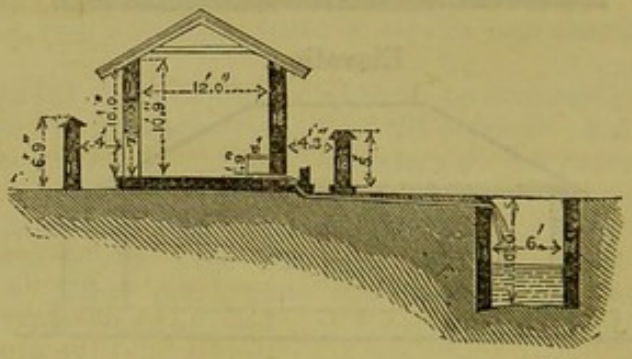


Almost everywhere it is said, as at Nusseerabad, Kirkee and Poona, and Dinapore, all of them large and important stations, "barracks "and hospitals" are "only wet" or "damp" during the "rainy months," as if it were a proof of great and unusual precaution in construction which builds buildings to be dry in dry weather.

At Fort William it is stated that the fluid refuse is swept away by garrison sweepers and water carriers, with the *aid of a fire engine;* that much of it evaporates ; that the outlet is a foul ditch.

Dinapore also boasts of a foul ditch, often very offensive. At Poonamallee the "foul ditch" surrounds the fort and encloses the hospital ; and "all fluid refuse sinks into the subsoil where it falls."

At Cawnpore is the singular statement, that the drains are "not "intended" for draining cookhouses, privies, &c. Here, as elsewhere, the drainage is effected *by hand;* that is, everything that will not evaporate or sink into the ground is carried away to a distance in pails, skins, or carts, and emptied out.

At Meerut the cesspools are cleansed "by opening the tops and "drawing out the fluid in buckets." It is said "they seldom require "cleansing." We may infer from this what a condition of saturation the subsoil must be in !

Agra employs all the powers of nature, and none of its own, to get rid of its "fluid refuse;" evaporation, sinking into subsoil, &c. Nature, however, is dilatory, which renders "raised paths necessary between "the barracks." The water from the lavatories is collected in an open

INDIAN DRAINAGE SYSTEM.

cesspool, from which it is *spread over the ground.* The hospital cesspits are deep wells, *never cleaned.* It is "tried to keep them sweet by "lime, *but in vain.*" (Probably.)

At Umballa the surface water "disappears with tolerable rapidity."

Meean Meer, the new station for Lahore, has no drains about the barracks. The water lies for hours. The lavatory cesspools sometimes overflow, saturate the ground, and taint the atmosphere.

These cesspools, as in Fig. 3, were intended for saturating the ground with foul matter, and out of the same ground the well water is taken.

Is not the whole history here of the late frightful cholera at Lahore?

And why cannot the refuse which does so much mischief by remaining be used to do good, and raise any amount of vegetables in soldiers' gardens?

Ferozepore tells the same story of no sewerage or drainage. Also at Ferozepore the lavatories *are* brick and mortar floors, "adapted for "receiving and draining off the water into the subsoil outside, so that "the men may freely bathe themselves!" There is no bath except the aforesaid floor. So at Peshawur and Sealkote is the same want of all sewerage or drainage.

At Berhampore, with its square mile of cantonment, only one cart is allowed to remove the contents of the privies to "holes a mile from "barracks." The vicinity abounds in jheels and foul ditches, with putrid water.

Allahabad, one of our largest and most important stations, in one of the worst positions, as if that position were not unhealthy enough by itself, trusts to nature again, has no drainage nor sewerage, and leaves its surface water to "evaporate," "percolate," and "run off."

Benares follows in the train. At Rangoon the drainage is supposed to run up-hill. For we are told that all sewerage and drainage are merely "trenches made without reference to slope."

Landour, which is a hill station, has every house damp for three months in the year. Yet their "spacious lavatory, with brass basins," is not much used, "from the scanty supply of water in the dry season."

It is evidently quite possible to locate the whole army on hill stations, and leave it more unhealthy than on the plains.

Nynee Täl, also a hill station, lets all its fluid refuse flow down to plains below.

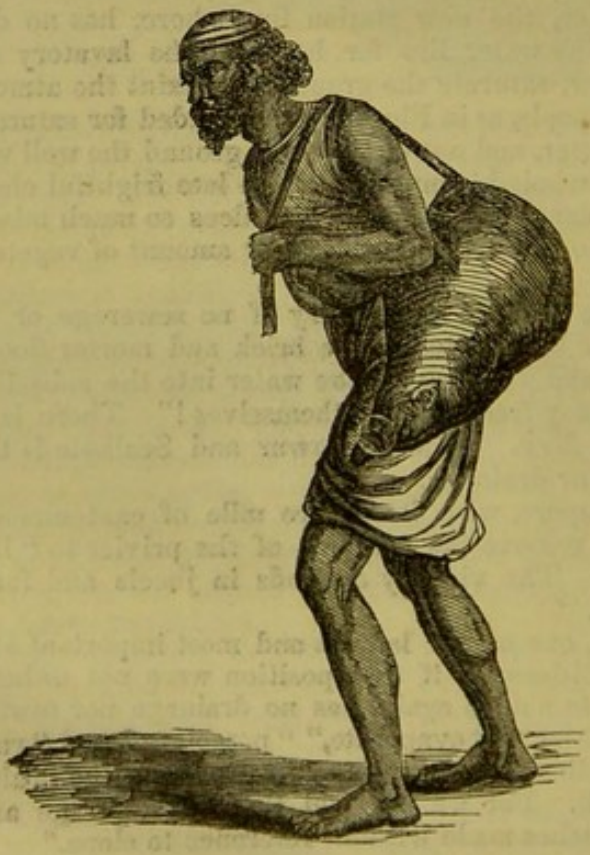
It is impossible to pursue this subject further. There are such much worse things in the Stational Reports than what I have chosen to give, that I must say to those who call my "bonnet ugly," "There "are much uglier bonnets to be had."

The system of water supply and drainage in India may be briefly defined as follows: they draw water from a well, not knowing whence it comes, and if there be any means to drain off water it is into a cesspit, or into long, open, pervious drains, not knowing whither it goes. Where this is not done, all the fluid refuse is collected in open cesspits, and carried away by hand-labour or carts; or else it is allowed to dispose of itself in the air or earth as best it can.

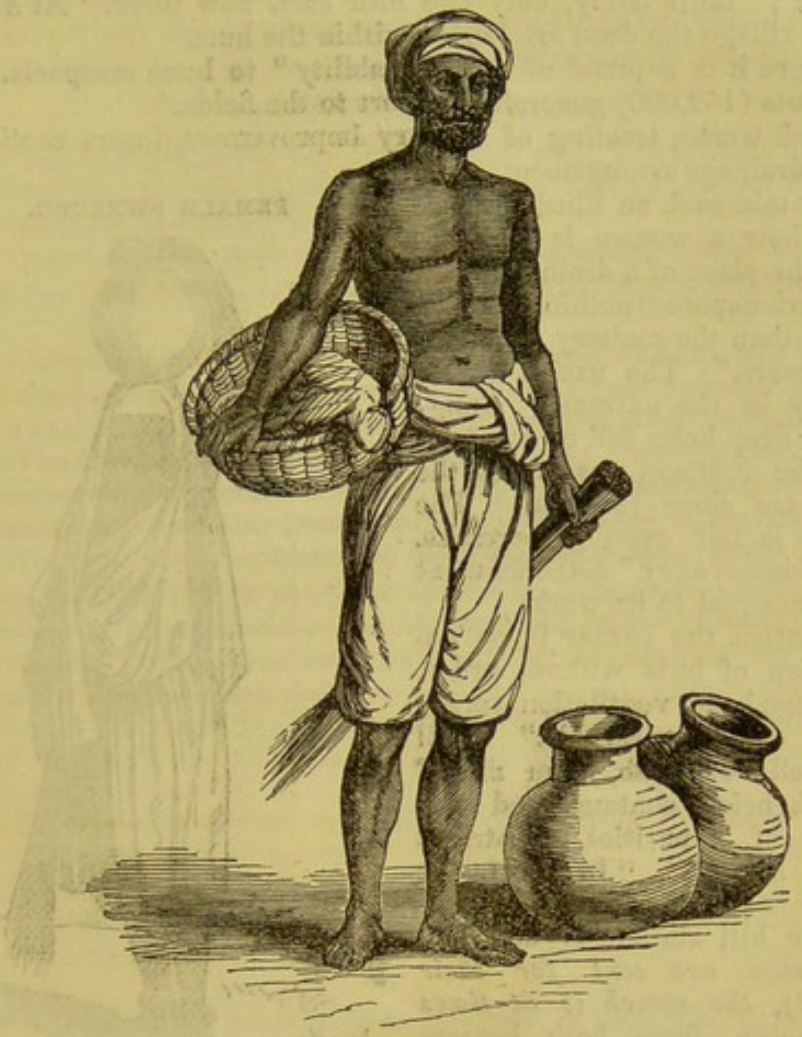
Drainage, in the sense in which we have found it necessary for health in this colder climate, is by no means considered necessary for health in the hot climate of India; for, as in the case of the water supply, most of the reporters consider *no drainage* a sufficient guarantee for health.

These two officials represent the system of water supply and drainage in India for garrisons and towns.

BHEESTIE.



MEHTER.



(3.) *Filthy Bazaars.*

It is almost impossible to describe these. But one description will do for all. Except where the two Lawrences have been—there one can always recognize their traces—the bazaars are simply in the first savage stage of social savage life.*

No regular system of drainage, no public latrines, or, if there are any, no sufficient establishment to keep them clean, no regular laying out of houses, overcrowding, bad ventilation, bad water supply, filth, foul ditches, stagnant water, jungle, and nuisances, this is the account of all. The country round some is stated to be "one immense privy."

At Neemuch the Bazaar Superintendent maintains "strict super-"vision," and "punishes the inhabitants," although the latrines cannot be used. The native houses are all more or less dirty, with dung-heaps close to them. The "disagreeable emanations" from the bazaar are felt in barracks.

In Dinapore some streets were impassable dunghills "last year," "until cleared." The elephant sheds and all the south of the station in a state disgraceful to any cantonment. The drains, deep holes of

* Dr. Julius Jeffreys tells us, in his evidence, that "the bazaar pigs, which were "chiefly eaten by the European soldiers, were the chief scavengers." Think of eating those useful officers! and without providing any others!!

festering mud. No latrines, although "the population is as thick as "can be;" until lately, only one filth cart, now three. At a neighbouring village the dead are buried within the huts.

At Agra it is a proof of "respectability" to have cesspools. The inhabitants (152,000) generally "resort to the fields."

English works, treating of sanitary improvement, insert sections of the bad drainage arrangements. But none contain such an illustration as this of how a woman is made to supply the place of a drain tile.

FEMALE SWEEPER.

At Berhampore "nothing can be "worse than the sanitary condition "of bazaars." The native houses are dirty in the extreme. Dung-heaps or deep holes full of stagnant water, the common cesspit of the houses, are close to them. The nuisance is felt even at barracks. The "Conservancy" establishment is quite unequal to its work.

At Muttra the bazaar is an accumulation of huts without order. "Drainage bad; ventilation worse; "water supply execrable." "All "the wells brackish, from nitre," the earth being contaminated with all sorts of impurities. Latrines "hardly known." "In short, the "bazaar is a mass of filth."

At one hill station, Nynee Täl, where *men are sent for their health (!), the stench is at times overpowering*, from both bazaars being in a filthy and crowded state, no proper drainage or latrines, no means of preserving cleanliness, which causes nuisance, even in the barracks. At another, Darjeeling, among other defects, the native villages, writes the medical officer, "are the most filthy" he has "ever "entered, and it is quite sickening to walk through them."

At Jubbulpore, where every hut is crowded, where there are no latrines, where cleanliness is almost impossible, the same causes produce the same results.

At Cannanore the native houses have dung-heaps and cesspits within the compounds. Owing to the want of latrines, the "filth and in-"decency" are described to be what it is impossible to repeat. The dead are buried within the compounds of houses.

At Trichinopoly the water supply is bad, scanty, and brackish. The bazaar is said to be "clean," while the open cesspits are described as an "intolerable nuisance" when the wind blows over them. The native houses are ruinous and not ventilated. Levelling, filling up, pulling down deserted huts, &c., is urgently required, but not done.

Those who think I have given anecdotes and not fair illustrations, I refer again to the Stational Reports for further and fouler evidence.

These instances are enough to illustrate the subject. Bazaars are the real hotbeds of disease, and require sweeping reforms as much as or even more than the stations.

Native regimental bazaars, from which the soldiers procure supplies, are within military limits, and as much under military control as the ground on which the barracks stand, and *ought* to be kept in as good a sanitary state as the barracks will be when thoroughly improved.

(4.) *Want of Ventilation.*

The reports generally say, ventilation good, if barracks not overcrowded. But as the barracks are almost always overcrowded, we must conclude ventilation is bad.

Or they say, ventilation sufficient, because doors are kept open during day, which is as much as to say ventilation is sufficient because it is not.

At Kirkee there can scarcely be said to be *any* ventilation in barracks. There are pigeon holes in the roof, but during the rains, when ventilation is most wanted, these have to be covered with tarpauling. At Poona the weather side has to be "dammed up" during the monsoon. At Bombay it is said that ventilation is generally sufficient; "at least "there are no complaints," although "improvement is imperative."

At Kamptee the ventilation is described as "most faulty and defi- "cient," although there are three openings in the roof of each barrack. The windows are unglazed. At Ramandroog, a hill station, the doors are venetianed in the upper half, "a great disadvantage in wet "weather." Half-glass doors are required. At Bellary there are no windows. The doors are half venetian, half panel. At Trichinopoly, one of the very hot stations, the old artillery barrack is stifled by having only doors.

At Dinapore, where the ventilation is entirely by doors and skylights, "which latter, however, do not open," one may safely say, ventilation not sufficient when doors are shut (at night). In the "per- "manent hospital" at Dinapore, placed so that the "wind does not "blow across it," the ventilation is only "sufficient" when the doors are open.

At Allahabad the doors have to be closed in high winds, dust storms, &c.; and the ventilation, although there are roof ventilators and small windows over the doors, is generally insufficient. The hospitals of Allahabad, although they "face the wind," have "in most instances no "windows, except openings over the doors and in the roof." And the ventilation is pronounced to be "very defective," especially when the doors have to be closed.

So at Dumdum.

At Agra ventilation is said to be sufficient, provided the verandahs are not occupied for sleeping.

But the verandahs are occupied for sleeping.

At Landour, where sick men are sent to get well, there is both overcrowding and bad ventilation. There is no roof ventilation.

At Nynee Täl the air is said to be "pure" inside the huts, which means that they are always full of "smoke."

The cooling by tatties, *i. e.*, air passing through damp vegetable matter, often tends to produce ague.

External ventilation is often also bad, as at Dinapore, Allahabad, and Berhampore, not giving the barracks the benefit of the prevailing winds. This is a point of primary importance in India. At Muttra, although there is abundant ridge ventilation, the entire length, it is insufficient at night, simply because the barrack is in a position which the wind cannot reach.

At Allahabad one-third of the station is below the level of the river.

Generally, very little attention appears to have been paid to independent ventilation as a cardinal point of barrack construction. Doors and windows have been trusted to; yet they are so placed that men are often exposed in bed to hurtful draughts, and if shut, the fresh air is also shut out. Sometimes there is no glass in the windows, and when these are shut there is darkness as well as foul air.

A knowledge of the proper application of sanitary appliances to building in India appears to be as yet in its infancy.

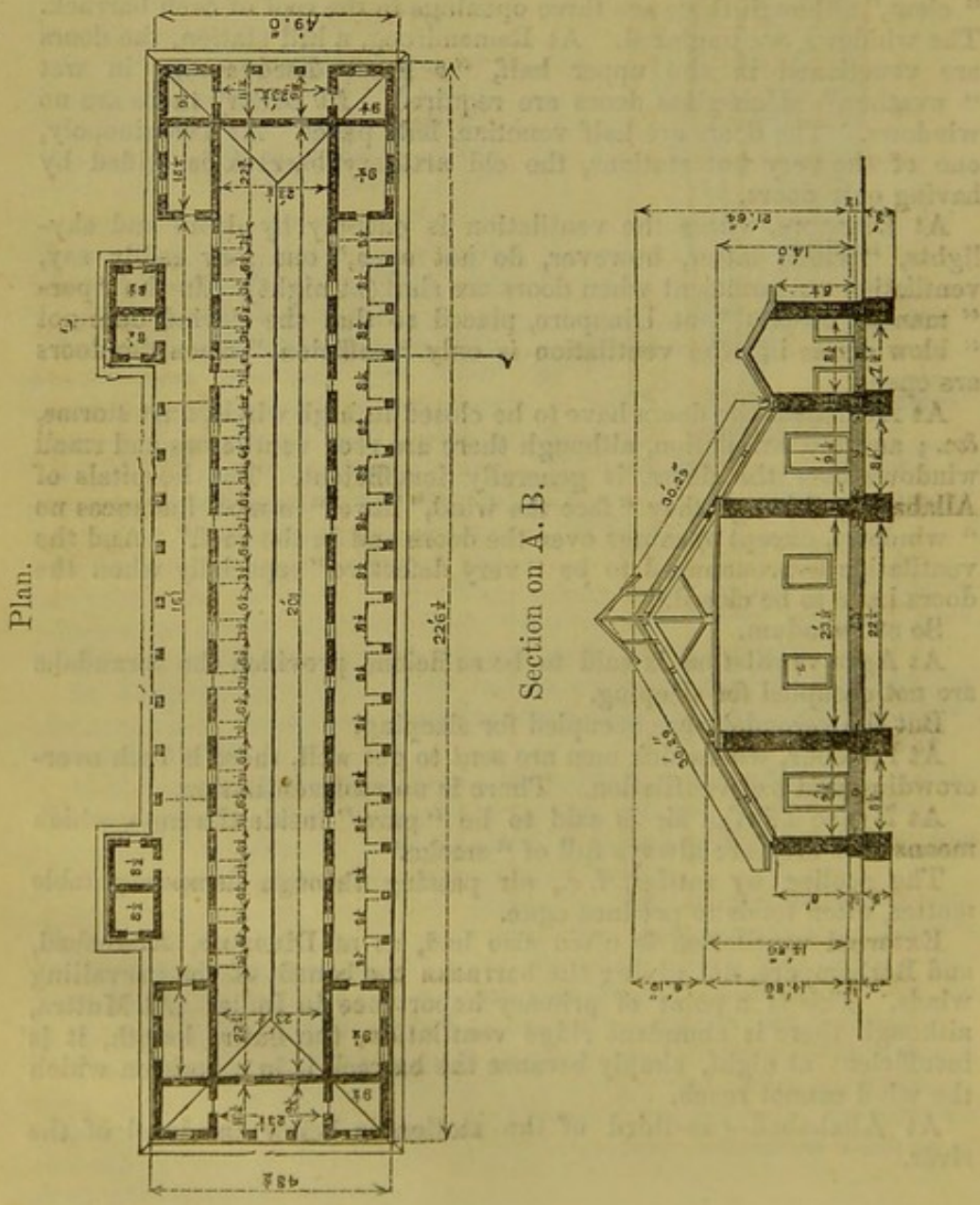
(5.) *Surface overcrowding.*

The structure of Indian barracks varies much. But in one thing they almost all agree, viz. in crowding the men upon the floor.

Fig. 4 represents a plan and section of a hut room at Deesa, no less than 200 feet long, intended for 80 men, at 1,116 cubic feet per man. It is well constructed for ventilation, and is altogether one of the best

Fig. 4.

EUROPEAN BARRACK. DEESA.



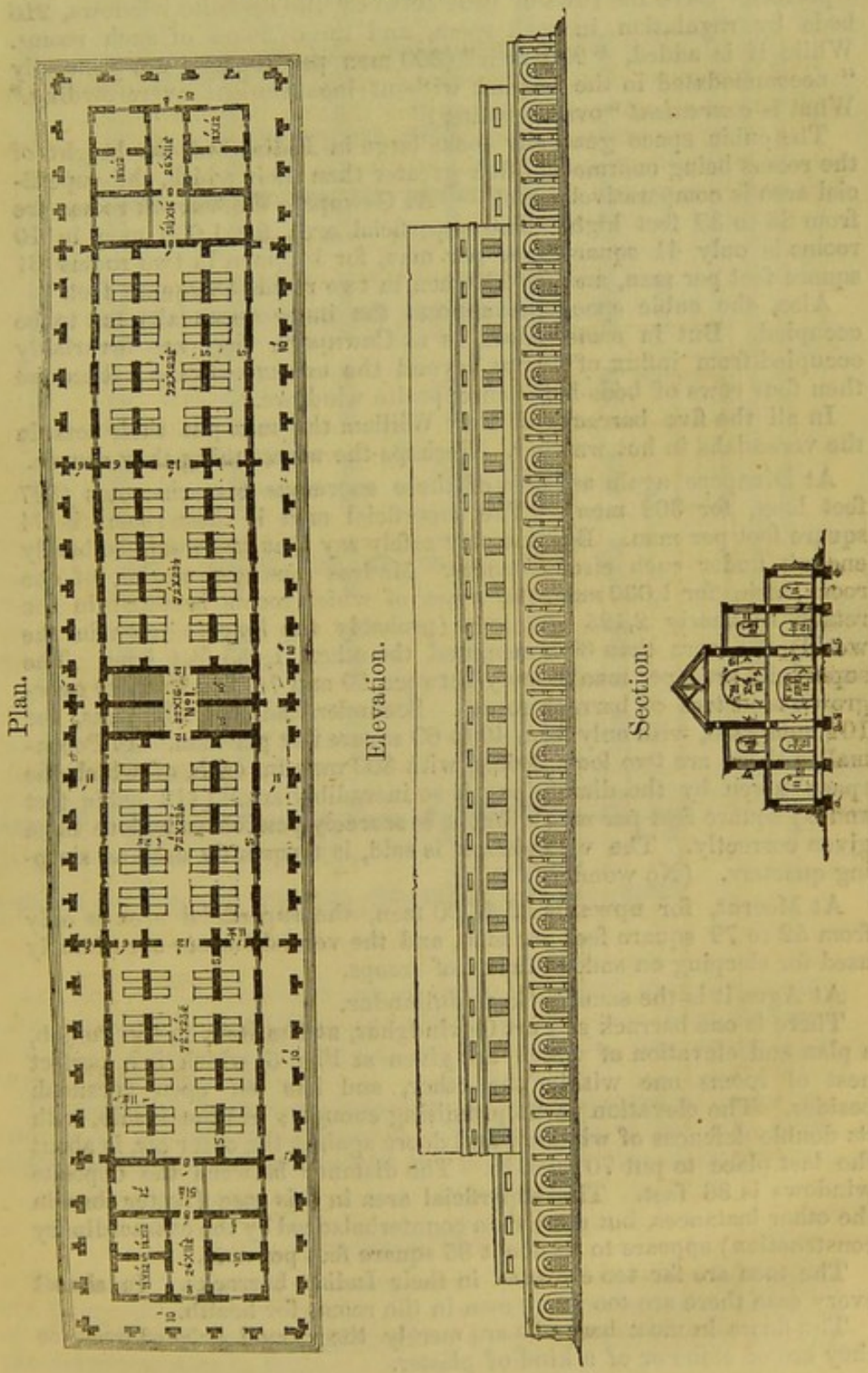
plans in India. But for its 80 men, which is just four times too many for any room, it allows less than 59 square feet per man.

Even in the most recent barrack plans there is the same defect.

Fig. 5 gives a plan, elevation, and section of the new barrack, either erected or about to be erected, at Mhow. The elevation shows a

Fig. 5.

INFANTRY BARRACK. MHOW.



magnificent and costly structure. But it is on two floors; it has double verandahs, the inner ones occupied by beds, so that there are four rows of beds, and 53 feet between the opposite windows; the ventilation of the whole interior is interrupted in rather an ingenious way by cross walls, and the men have 65 square feet of space each.

But even this is not the worst.

At Fort William, the Dalhousie barracks, which are said to be "perfect," have *six* rows of beds between the opposite windows, 216 beds by regulation in each room, and three floors of such rooms. While it is added, "900 men" (300 men per room) "are generally "accommodated in the barrack without inconvenient overcrowding." What is *convenient* "overcrowding?"

The cubic space generally looks large in India, but the height of the rooms being enormous, often greater than their width, the superficial area is comparatively small. At Cawnpore the barrack rooms are from 25 to 30 feet high. The superficial area for 1,000 men in 10 rooms is only 41 square feet per man, for 140 men in two rooms 61 square feet per man, and for 240 men in two rooms 88 square feet.

Also, the cubic space presupposes the inner verandahs not to be occupied. But in some places, as at Cawnpore, they are invariably occupied from influx of troops beyond the accommodation; there are then four rows of beds between opposite windows.

In all the five barracks of Fort William the men put their cots in the verandahs in hot weather. Perhaps the wisest thing they can do.

At Dinapore again are two of these enormous barrack-rooms (827 feet long, for 308 men). The superficial area in these rooms is 94 square feet per man. But one may safely say that 120 would be barely enough under such circumstances. Madras has two stories, of one room each, for 1,030 men, the upper of which rooms is stated in the return as nearly 2,125 feet long (probably the longest room in the world), for more than 600 men, and the other, 1,483 feet long. The superficial area per man is only between 60 and 70 feet in these overgrown monsters of barrack rooms. Secunderabad has 10 rooms, for 104 men each, with only from 40 to 60 square feet per man. At Poonamallee there are two long rooms, with 300 men in each, of which the space given by the dimensions is so incredibly small (112 cubic feet and 8½ square feet per man), that it is scarcely possible to believe them given correctly. The verandah, it is said, is frequently used as sleeping quarters. (No wonder!)

At Meerut, for upwards of 4,000 men, the superficial area is only from 52 to 79 square feet per man, and the verandahs are occasionally used for sleeping on sudden influx of troops.

At Agra it is the same. So at Jullundur.

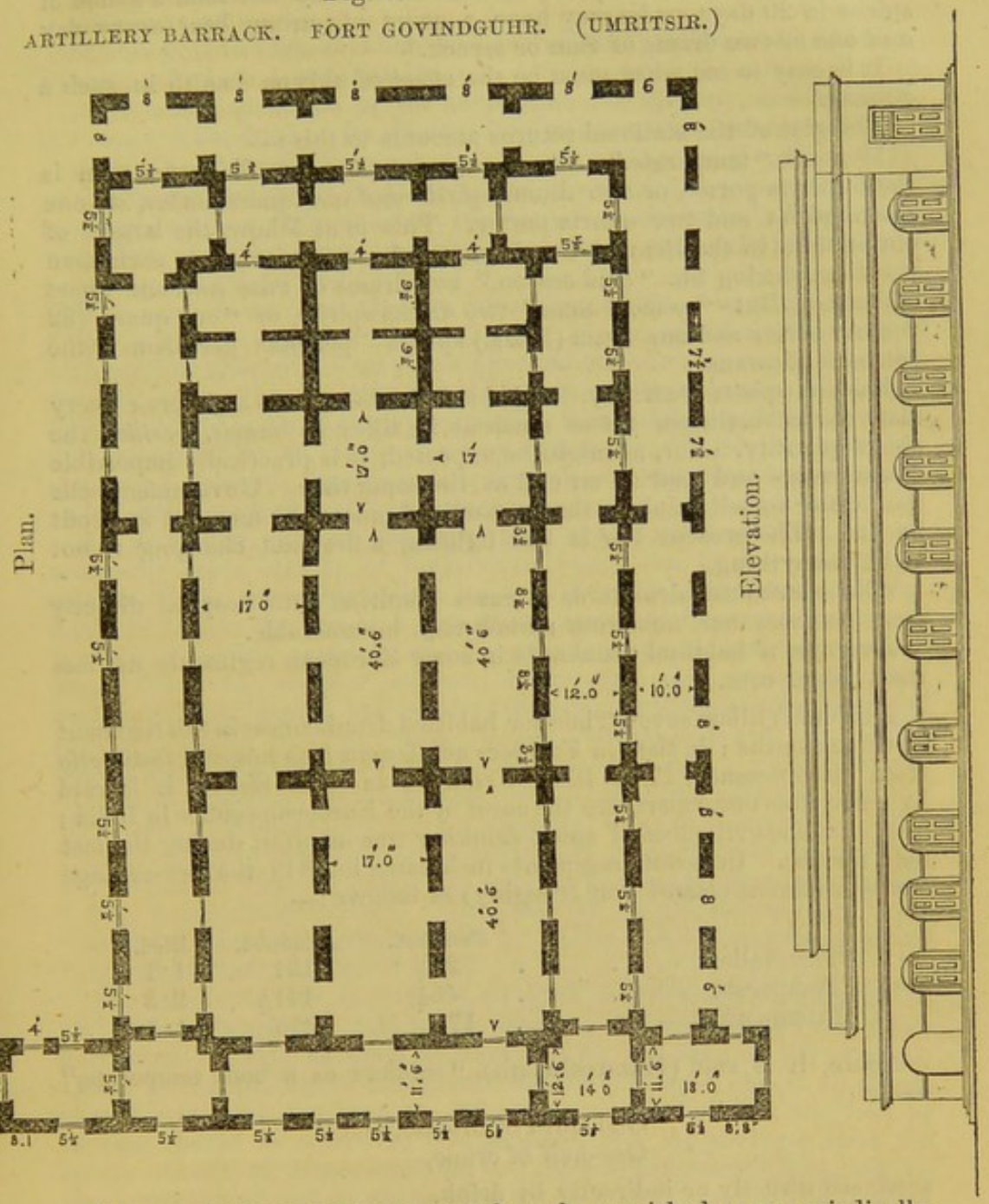
There is one barrack at Fort Govindghur, at Umritsir, in the Punjab, a plan and elevation of which are given at Fig. 6, which is a perfect nest of rooms one within the other, and has an open verandah besides. The elevation looks promising enough; but the inside, with its double defences of windows and doors against the outer air, is about the last place to put 70 men in. The distance between the opposite windows is 86 feet. The superficial area in this case (better than in the other instances, but more than counterbalanced by the extraordinary construction) appears to be about 85 square feet per man.

The men are far too crowded in their Indian barracks. In almost every case there are too many men in the rooms for health.

The floors in most barracks are merely the ground bricked over, or they are of stone or of a kind of plaster.

Fig. 6.

ARTILLERY BARRACK. FORT GOVINDGUHR. (UMRITSIR.)



At some stations the floors are of earth, varnished over periodically with *cow dung !* a practice borrowed from the natives. Like Mahomet and the mountain, if men won't go to the dunghill, the dunghill, it appears, comes to them.

To sum up: it is not economical for Government to make the soldiers as uncivilized as possible. Nature sends in her bill—a bill which always has to be paid—and at a pretty high rate of interest too.

III. Intemperance.

There is a good deal of intemperance among soldiers everywhere, but I very much doubt whether the same amount of tippling ever goes on in the British army in this country as appears to be encouraged by the canteen system in India.

A soldier in India may buy at the canteen no less than a gallon of spirits in 20 days, or he may have a quart of strong beer every day *and* one or two drams of rum or arrack.

It is easy to see what must be the effect of this on health in such a climate.

The gist of the stational returns amounts to this :—

Men all "temperate." The maximum allowance daily per man is three quarts porter, or two drams spirits *and* one quart porter, or one dram spirits and two quarts porter. This is at Mhow, the largest of our stations in the Bombay Presidency. Agra too issues to each man per diem, during the "cold season," two drams of rum *and* one quart of beer. But "no more than" two drams spirits, or "one quart (32 "ozs.) porter and one dram (3 ozs.) spirits" per man per diem is the common allowance.

Sale of spirits "strictly forbidden" in bazaar to soldiers; every man can nevertheless get as much as he likes in bazaar, *besides* the above quantity. For, as might be expected, it is practically impossible to encourage and restrict an evil at the same time. Government sells the licence to sell drink in the bazaar, and orders the men not to profit by it. The present law is like lighting a fire and charging it not to burn anything.

"No confirmed drunkards;" cases admitted into hospital directly from intemperance, numerous; *indirectly*, innumerable.

Average of habitual drunkards in some European regiments not less than 15 per cent.

At Fort William seven trials for habitual drunkenness in 8th regiment in three months; in the 5th Fusiliers admissions into hospital *indirectly* from intemperance, 17 in 100; *directly*, 2 in 100. Spirits, it is said by more than one report, are the curse of the European soldier in India; also, that the evil effect of spirit drinking was manifest during the last field service. In seven regiments in Madras in 1849 the per-centage among different classes was (roughly) as follows :—

	Punished.	Admitted.	Died.
Teetotallers . .	23½	131	1·1
Temperate . .	58½	141½	2·3
Intemperate . .	171	215	4·5

Again, it is said (Hazareebaugh), "soldiers as a body temperate," *and*

One-third of disease, and
One-half of crime,

produced directly or indirectly by drink.

The long-cherished idea as to the necessity of spirits for the British soldier is, it is stated, thoroughly exploded. A man who drinks tea or coffee will do more work than a dram drinker, though considered sober. And why? Because now we know that tea and coffee prevent waste of the system under exertion; while spirits afford no more than temporary stimulus followed by exhaustion or collapse, both of which conditions are powerful predisposing causes of disease, especially in an exhausting climate. It is an error to sell spirits in canteens to prevent men obtaining worse spirits in bazaars. It creates craving, to be satisfied elsewhere. Again and again it is said that selling rum in canteens is an unmitigated curse to a regiment, destructive alike to health and discipline; that it will be a "happy day" when nothing but beer, light wines, coffee, tea, lemonade, &c. are to be sold. Col. Greathed, than whom we have no better authority, says that he "should

"wish beyond everything to see the practice of supplying spirits in "canteens abolished."

In one year (1859), at Allahabad, there were 36 cases of delirium tremens, of which 5 were fatal.

At Umritsir one-sixth of the admissions are directly, and one-half indirectly, from drink. Its effect is "injurious to the last degree."

At Chunar, though the men are "mostly temperate," yet, on a 10 years' average, *one man in three* (!) of the admissions was admitted into hospital directly from drink, besides those indirectly. The deaths were just twice, the crimes just 10 times as many among the intemperate as among the temperate.

It is a comfort to hear that at Secunderabad the "average number "of confirmed drunkards varies." But 25 out of 26 cases admitted into hospital indirectly from drink (Secunderabad's statement) is really too bad. Though when it is added that, in this large station, occupied by nearly 3,000 men, there is so little for them to do that they "go out "in search of liquor," it is the less surprising. And the immense amount of epidemic dysentery that sweeps over the place occasionally under such a system is still less surprising.

At Bangalore, one of the largest of our Madras stations, where numerous acute attacks of disease are brought on by the quantity of spirits drunk, notwithstanding its fine, healthy, temperate climate, 3,000 feet above the sea, it is stated that, probably "not three men out "of five go to bed perfectly sober," and when pay is issued not two in five. That, of one-year soldiers, 1 per cent. is a drunkard; after two years 2 per cent.; and so the proportion increases with length of residence, owing to their "idle, listless, objectless lives." In India, temperance is the exception and intemperance the rule. "But Govern- "ment is to blame." It "bids them drink freely," and when the habit is confirmed "denounces them as a disgrace to their country." "The "habitual daily two drams ruin the health and habits of the soldier, "who thinks that as long as he takes only what Government allows "him, he cannot go wrong." The taste for spirits, it is said, is "not "easily acquired by young soldiers." "The habit of spirits is main- "tained by their authorized use."

The temperate men, it is stated, all drink occasionally; impossible to say how much spirit is sold in the bazaars. At present the collectors encourage the sale as much as they can for the sake of the revenue. Under no circumstances, except extraordinary fatigue, almost all agree, should any drink but beer, tea, or coffee be allowed, and the loss of revenue should be otherwise compensated for. Acquiring a taste for spirits should be discouraged in men by every means. It should be absolutely interdicted on the passage out, and malt liquor given instead, with good food, good water, and good accommodation. For want of these, about 10 per cent. of the recruits arriving from England at Kurrachee have in certain years suffered from scurvy.

"All spirit drinking is injurious to health." "Nine-tenths of all "the crime is caused by it." "It is directly or indirectly the root of "all evil in the army." Such is the testimony borne in these reports.

In Burmah, when malt liquor could be had, health always improved. A marked change for the worse took place when spirit was issued instead.

Where beer was introduced, the "tremulous, yellow-skinned, "emaciated" spirit drinker was rarely met with.

Madras Presidency says that "health, efficiency, and discipline would "be materially improved by tea and coffee in preference to spirits and

" malt liquor," " as has been proved when neither spirits nor malt liquor " could be had."

Barrackpore says that, if spirits were abolished and dietary improved, the mortality among our men would be " extraordinarily " diminished."

Fatal cases (in sickness) mostly occur among intemperate men.

There is hardly a difference of opinion as to the necessity of abolishing the use of spirits in the Indian army. Men would be blind, indeed, to the most glaring facts who would justify its continuance. The only plea on the other side in the reports is a very old one, which has been used to justify other vices besides dram drinking, viz., that if we do not give spirits in the canteen, which we all believe to be bad for health and discipline, the men will get worse spirits in the bazaar. Thus the men are killed by liver disease on canteen spirits to save them from being killed by liver disease on bazaar spirits, Government in either case benefiting pecuniarily, as is supposed, by the transaction. May there not be some middle course whereby the men may be killed by neither bazaar nor canteen spirits ?

IV. Diet. *Excess of Food.*

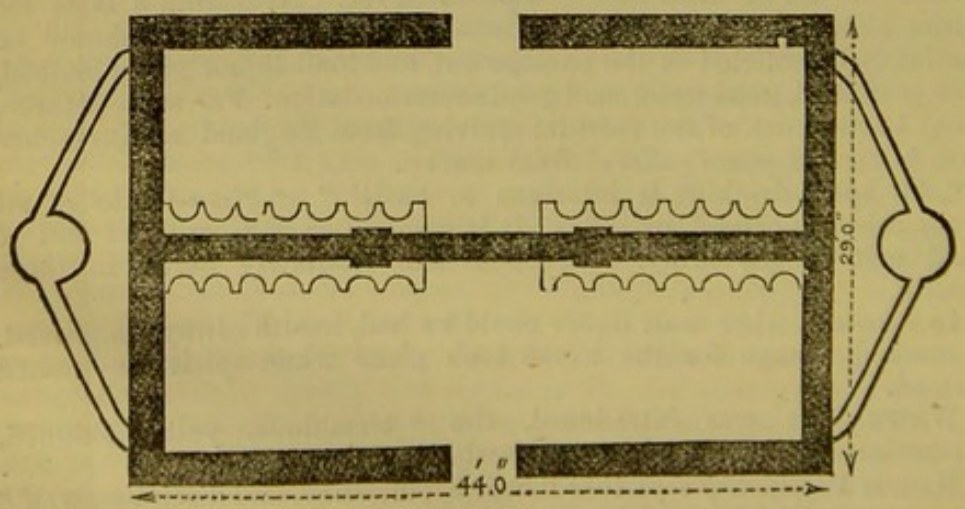
It appears extraordinary to give the soldier the same amount and quality of diet in all seasons, in tropical as in temperate climates. And yet every day the soldier has 1 lb. animal food, 1 lb. bread, 1 lb. vegetables, 4 oz. rice, tea or coffee, and sugar, besides his spirits and beer, and any amount of extra animal food he may buy for breakfast and tea. Of all countries India is the one where men cannot be dieted the whole year round by the same rule without mischief. But only a few enlightened men appear to have any idea of what effect this extraordinary system of dietetics has on the soldier's health.

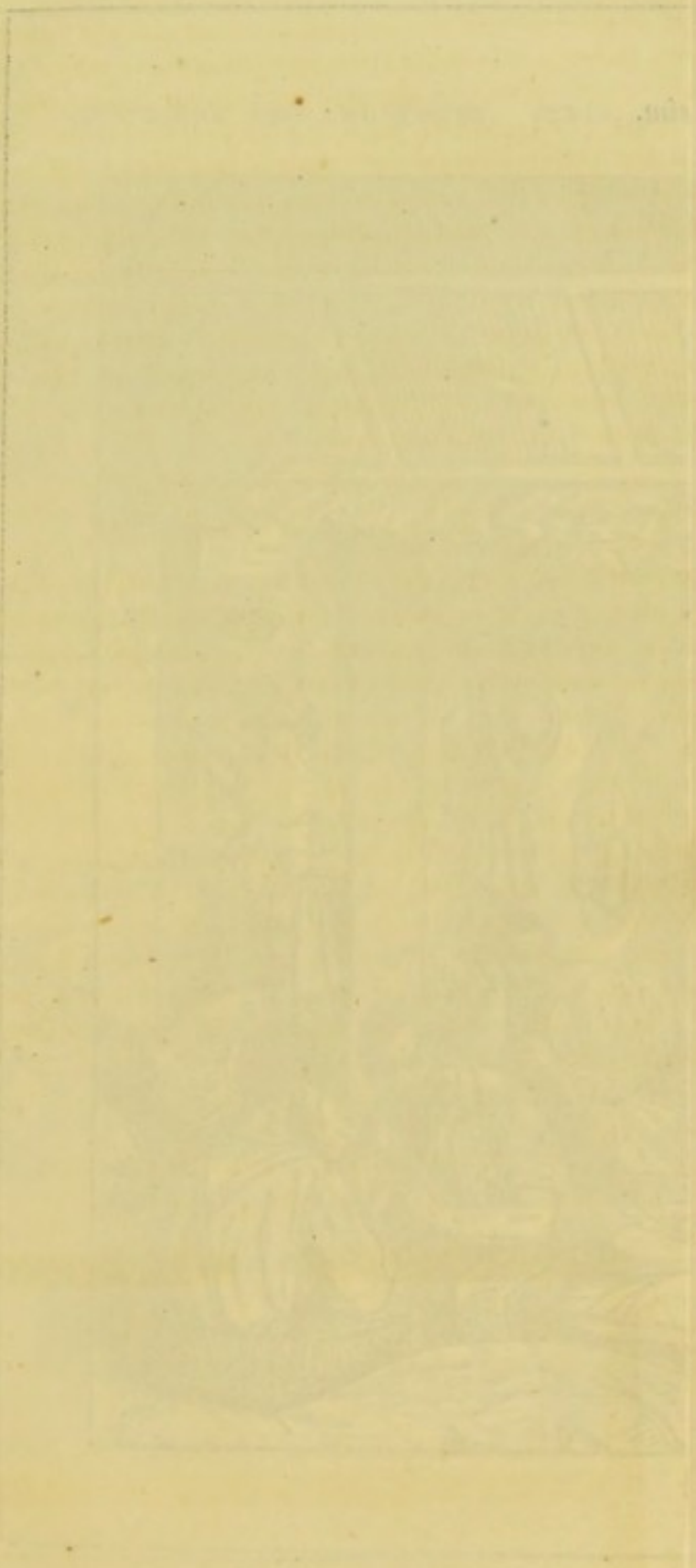
Surely we have sufficient knowledge of dietetics to be able now-a-days to vary our diet to suit climates and seasons, and to know that we cannot eat everything everywhere. Sir John Lawrence says in his evidence that Government " might try to induce the men, by varying " the ration with reference to hot or cold weather, to take more to " vegetable diet."

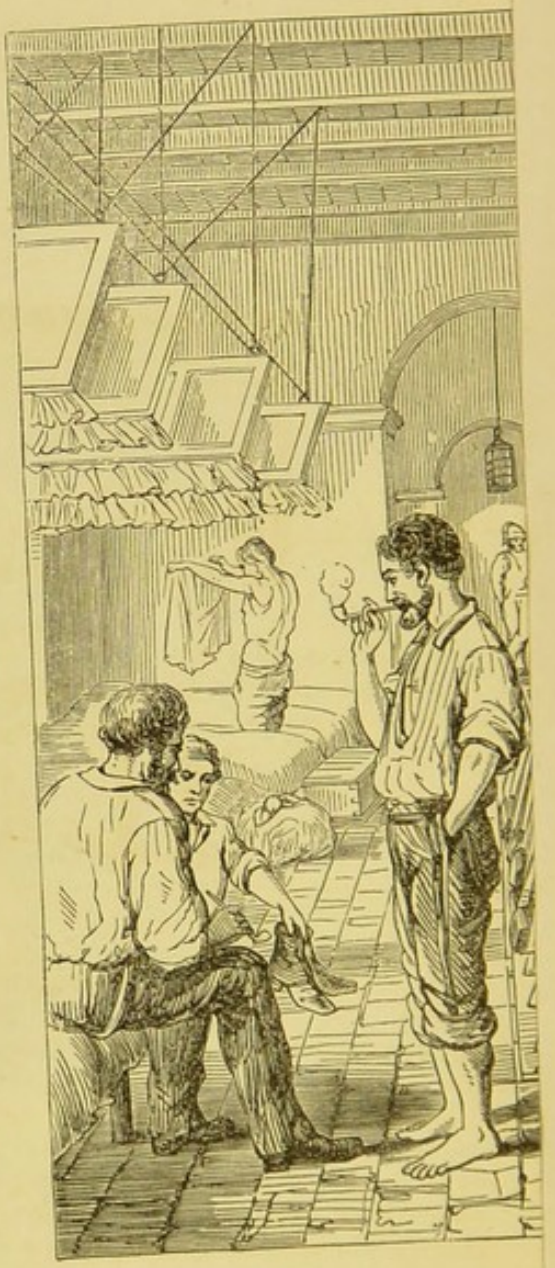
Fig. 7.

COOK-HOUSE. HAZAREEBAUGH.

Plan.







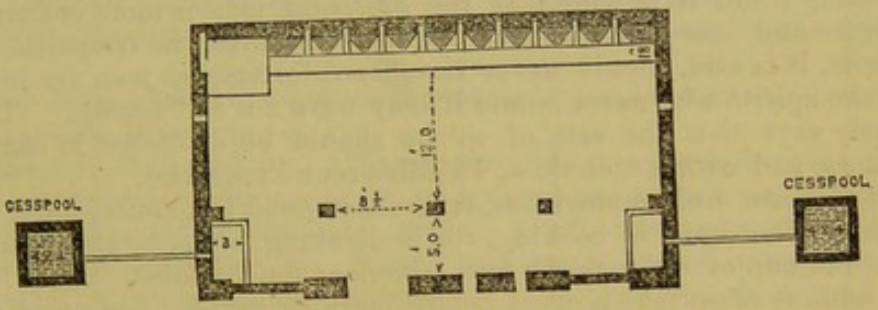
The means of cooking are of the rudest order—a small square outhouse, sometimes without a chimney, often far from clean, is the regimental kitchen. As for boilers and ovens, considered indispensable at home, there are none. A few holes to put the fire in, and moveable utensils to hold over them, are all that India thinks it wants. There is, of course, no water laid on, and no drainage. Here as elsewhere is the inevitable cesspit, and sometimes there are two.

Fig. 7 is a plan of a double kitchen at Hazareebaugh. Fig. 8 is a by no means bad example at Belgaum. Both show the total want of civilised appliances. And although the cooking is not often complained of by the stations, there is very good authority for stating that the food is imperfectly cooked, or served up in a way which destroys the digestive organs, and leads to the use of stimulants to promote digestion.

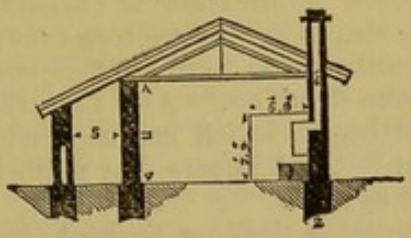
Fig. 8.

ARTILLERY COOK-HOUSE. BELGAUM.

Plan.



Elevation.



V. Want of Occupation and Exercise.

To understand the influence of this system of dieting and drinking, it must be remembered that, except morning and evening parades, and the man's turn on duty, he has nothing in the world to do. He can neither amuse himself, take exercise, nor turn his time to profit for himself, for there are no means of doing any of these things. All the spare time people usually give to active occupations he spends lounging in his hot barrack room, most of it on his bed.

The accompanying graphic woodcut of the manner in which a soldier spends his day is from a drawing kindly sent me by an Indian officer of rank. (*See opposite.*)

India actually reverses the ordinary human day, for the men spend 18 hours of the 24 in or on their beds, and six hours only up or out. Indeed Kamptee says that "for many months of the year the men are "confined to barracks for 20 out of 24 hours." And your imagination must fancy 100 to 600 men or more packed into the same room for eating and sleeping away these 20 hours.

This is an account of a soldier's day :—

bed till daybreak ;
drill for an hour ;
breakfast, served to him by native servants ;
bed ;
dinner, served to him by native servants ;
bed ;
tea, served to him by native servants ;
drink ;
bed ;—and *da capo*.

So that the Briton exactly spends his spare time between eating, drinking, lounging, or sleeping ; and he eats meat always twice and sometimes three times a day.

All his meals are condensed into the hot hours of the day. And just when he wants one most, viz., *before* he goes out to his early morning work, he does not get it. Why not give him hot coffee before morning parade, and beer, if he must have it, at dinner and at night ? Not one report except Tonghoo but prays for the abolition of all this dram drinking ; and it is said that the *abstinent* man is more enduring of fatigue and less obnoxious to disease than even the *temperate* man. Spirits, it is said, should never be offered for sale, as men are induced to take spirits who never would if they were not so "handy." Trichinopoly says that the sale of spirits should be abolished in canteens, bazaars, and within a circle of 10 miles round barracks.

If the men had employment, recreation, good tea, coffee, milk, more variety of food and of cooking, spirit drinking might be abolished. A good hot cup of coffee is the best stimulant for a soldier. As it is, the old soldiers often take a dram before morning parade, and nobody can prevent them.

The following piece of information is curious (the scene lies in the Madras Presidency), viz., that "the canteen funds" (the profits derived out of the soldiers' drunkenness) "are insufficient to provide amusements "to keep the men from drinking." Also that where there is no library there are "plenty of books which can be read till 8 p.m., when all "lights are put out." Berhampore has a library and reading-room, but "neither lighted at night."

That want of occupation, leading to drink, lays the seeds of disease among the troops, is acknowledged. "Alcohol and unrefreshing day "sleep," says Bangalore, "contribute to engender disease and accele-"rate mental and physical decay." Ahmednuggur says that, for one man occupied in a barrack, there are six idle. Also, that when men are actively engaged in the field in hot weather, there is little sickness or epidemic disease among them. So unaccustomed is the soldier to ordinary exertion that, as might be expected, the short parades are talked of as injurious, as if they were long harassing marches ; while, curiously enough, it is admitted that the soldier is never better than when he is exposed to the harass and fatigue of field service.

Kolapore and Belgaum say that the more varied and agreeable a soldier's occupations, the better his health ; that the troops require means of occupation and amusement to keep them out of the bazaars.

All the sensible reporters say that too much stress cannot be laid on the importance of using the utmost exertion to provide legitimate amusement and occupation for the men—workshops, shelter for athletic games, &c. We must always remember that, in hot weather, the men, save those who can read, "have positively nothing to do." Employment on public works "would be a great boon ;" "the work would be "as cheaply done as now ; it would occupy the soldier, and he would

"feel he was doing good." Savings banks would answer, "if work-"shops for trades were established." The usual account from a station is, no library, nor reading nor day room, no club, no garden, no workshops, no theatre, no gymnasia, no means of instruction or recreation whatever, no skittle grounds, or if there are any, not covered, no sufficient shade for exercise. And the men are generally confined to barracks from 8 a.m. to 5 p.m. in hot weather.

Cawnpore actually orders the men to be confined to barracks for 10½ hours a day in hot weather; but the order "is often disobeyed." At Chunar there is no restriction as to exposure to the sun. The "men "go about at all times, and, except when under the influence of liquor, "do not appear to suffer from exposure." Yet Chunar's mean temperature is 65° in December and 92° in June, its sun temperature as high as 120° in June. And yet the men do not "suffer from exposure."

Agra, Ferozepore, and Umballa say that a large covered building for gymnastics, workshops, games, with a library, reading, and coffee room, a theatre, and plunge baths, "would draw many men from their "cots, where they idle and sleep all day." And Peshawur recommends that this building should be separate from barracks.

Dinapore recommends a farm-yard to employ the men: an excellent idea.

Meean Meer (Lahore) suggests photography, modelling, and drawing as occupations for the men.

Sealkote (1,200 men) and Ghazeepore (850 men) may be offered as examples of the two opposite types of rational occupation and idleness.

Sealkote, indeed, is the only station, except Rangoon, which has anything like completeness. It has ball courts and skittle grounds. It has schools and regimental libraries. It has a well-lighted reading room, with chess, backgammon, dominoes, and 16 newspapers, &c. It has a soldiers' garden, with seeds and tools provided by Government, who grant prizes for the best cultivation (*soldiers'* gardens, when they exist at all, are elsewhere worked by *natives*). It has armourers' saddlers', tailors', shoemakers', and one watchmaker's shops. It has theatres; it has cricket and regimental clubs; it has foot-ball, and it is particularly fond of quoits. The savings bank of one of its regiments has 8,000*l*. It has sufficient shade for exercise. Yet Sealkote does not think it has done enough. And while other stations, whose men "lie in their cots all day," seem unaware that anything else is desirable, Sealkote wishes that "workshops for every trade" were instituted, as they might be, and "strongly recommends" a gymnasium.

It is noteworthy that the health of the troops at Sealkote seems to require but little amendment, and that no complaint is made of its climate.

Rangoon has a ball court and skittle grounds; schools, three libraries and day rooms; soldiers' gardens; shops for trades; two theatres. But Rangoon says it requires lofty open sheds for gymnasia; and that Government should afford every aid in establishing good coffee rooms, *independent of canteens*,—all amusements to be as near as possible, all canteens to be as far as possible, from the coffee rooms.

Now take Ghazeepore. Its whole means of occupation, instruction, and recreation are one ball court and two skittle grounds. Its whole shade consists of the verandahs, under water during the rains. "Almost "everything has yet to be done."

The large station of Allahabad (with accommodation for upwards of 4,000 men) is almost as ill off. Tonghoo, the only station which considers the quantity of spirits drawn as "conducive to health," and the

amount of "sickness, mortality, and crime occasioned by intemperance" as "trifling," has, as might be expected from this statement, absolutely no means of occupation and amusement for its men, and few of instruction. It appears to consider drinking, idleness, and illness the normal state of things. At Bangalore (1,700 men) "day rooms, soldiers' "clubs, workshops, theatre, gymnasia, and gardens are things unheard "of." The "regimental library has no attractions for men who read "with difficulty." This is the place where, as soon as "the noon-day "gun announces that the canteen is open, a rush is made for the raw "spirit dram;"—where "the canteen and the cot divide the hours "unoccupied by the daily routine of petty duties." What else can be expected? There is of course plenty of liver complaint here.

But amusements are not all that is required. In conformity with all reason and experience, Sir Charles Trevelyan observes that, however necessary and useful chess and backgammon, ball courts, and skittle grounds, and even books and newspapers may be, they only furnish some present diversion, and do not supply any strong pervading motive, such as induces men to submit to sacrifices, and to make persistent exertions in other lines of life. This motive is to be found only in the hope of rising to a higher and better position. He advocates a system by which every soldier who conducts himself well and cultivates himself so as to acquire a knowledge of the native languages and other necessary attainments, should be able to look forward to promotion as a matter of course, either in the army or in the commissariat, ordnance, or other military departments, or in the department of public works or police. The British soldier in India would then feel himself engaged in the serious business of life, at least as much as any of his countrymen of the same class at home. The army would take its tone from the active influential portion of the men. The amusements of various kinds provided for the soldiers would be more appreciated and would have a more wholesome effect, because they would take their proper place in subordination to higher interests.

This is no theory. It was actually carried out by Sir C. Trevelyan at Madras. Men were first selected by competitive examination within the regiment. There was a second examination at Madras, and the result was the obtaining "of 20 men who were the pick of the whole "army for the administrative service of the Government in the civil "and military departments."

One element essential to placing soldiers in positions of civil usefulness is, of course, their learning the language of the country, necessarily part of that voluntary education which they must have for competitive examination. Learning the native languages in regimental schools would at once provide the men with interesting occupation and the prospect of future advantage. The War Office has already sent to all European regiments in the Madras Presidency a cheap edition of the New Testament and Psalms with a Clavis in Hindostanee, in furtherance of this object.

Sir C. Trevelyan would also encourage trades and handicrafts to the full extent consistent with the means of profitably disposing of the produce. And this is the more necessary, because all are not equal to the intellectual acquirements to which the previous remarks refer.

All officers who give an opinion on the subject concur in recommending workshops.

Dumdum, in the total absence of all means for occupying the men, opens a small museum, with lectures, to which the men crowd, showing "that soldiers are ready to avail themselves of any means of rational

" amusement in the evening in preference to spending all their time in " the canteen."

Muttra, again, has no means of instruction, occupation, or amusement whatever, except a soldiers' garden, for which there are no tools, although indented for a year ago. Carpentry, saddlery, and coopers' work are in great demand, and would benefit the men as regards health, morals, and finance.

Lucknow is building everything that is required, except workshops.

Rawul Pindee has nothing but schools.

Barrackpore petitions for fives courts, a theatre, gymnasia, swimming baths, public reading of good biographies, travels, and novels; for trades, such as clothing, accoutrements, barrack furniture, watch making, printing, paper making, baking. It says that savings banks should be connected with workshops.

Darjeeling has a hospital, reading room, and reader; a very good plan. But for its men out of hospital, at a hill station, where the rain falls incessantly for five months, there are no means under cover provided, and the men are pent up in barrack-rooms, to the great injury of their health. Darjeeling says, " there should be restaurants where men " could get coffee, tea, newspapers, magazines, *and mix with men of* " *other regiments*, instead of the discomfort of the everlasting " barrack-room."

Hazareebaugh has a Government library, *not* lighted at night, a temperance reading-room, well lighted, with upwards of 200 members (out of 1,080 men, for which number the station has accommodation), and, although it has armourers', shoemakers', and tailors' shops, it strongly recommends further means of occupation and amusement, " as " the long days of the Indian hot weather hang heavily on the soldiers' " hands."

This part of the subject is by no means exhausted, but these examples and illustrations are quite sufficient to show the small amount, indeed, of physiological knowledge which has been practically applied to the British army in India.

Suppose any one wanted to try the effect of full diet, tippling, and want of exercise, in a hot climate, on the health of men in the prime of life, the Indian army method would be the process to adopt, in the certain expectation that every man exposed to it will be damaged in health.

While all this scientific " turkey stuffing " is practised, the men are carefully kept in barracks, and not allowed to exercise themselves. And everybody seems to believe that the way of making diseased livers in geese for Strasburg pies is the best way of keeping men's livers sound, and of making efficient healthy soldiers for India. Wherever the regimen is otherwise, as in the case of cavalry and artillery, who have some exercise, or where an enlightened officer allows his men to go shooting, there is, of course, improved health. But nobody learns the lesson.

People seem to consider that health is a natural production of India, instead of being the result of rational management. At the same time everybody says that India is " so unhealthy." Under this system of diet, regimen, drink, and idleness, it is indeed to be expected that cases sent to the hospital will be much more numerous, much more severe, and much less amenable to treatment and management than under a sensible system.

VI. Hospitals.

The Indian hospitals, though planned on simple principles, admitting of admirable details, are, as a rule, exceedingly bad as regards points considered essential to health and administration, even in temperate climates. What would be, *e.g.*, thought in this country of a hospital without a watercloset, or bath, or means of personal cleanliness? Such a hospital would be considered as a mere makeshift, till accommodation fitter for recovery could be provided.

The "means of ablution" in Indian hospitals are often a "tin pot, "with which the sick pour the water over themselves;" or, as at Bombay, they "take water to bathe themselves from a trough." Elsewhere they have "one tub, one basin to 100 men." The means of washing, as at Ramandroog, a convalescent station, are "two shallow "earthenware pie dishes," "on a form in a room" ("very chilly in "damp" weather) "adjoining where the night stools are."

At Rangoon the "bathing accommodation" is "hitherto nothing but "a tub of water, without basin, soap, or towel."

There may be a bath room. But "all apparatus is entirely wanting." The sick "can always, if they please, get a skinful of water thrown "over them by the water carriers," as at Hazareebaugh.

One may safely say that when the sick are able to bathe in India, it is a sufficient test of their being able to leave hospital, as has indeed been discovered to be the case at some home stations.

At Nynee Täl the sick bathe in the lake. Darjeeling says, "in fact "the inducements to remain dirty are, especially in the case of sickly "men, greater than those to be clean."

There does not appear to be a single well-placed orderlies' or nurses' room in any of the hospitals, from which the sick can be seen at all times, and where the nurses themselves can be inspected. The surgeon's and "nurses'" quarters are sometimes three-quarters of a mile or a mile off, so that they (the medical and nursing attendants) are represented as spending their whole day in going backwards and forwards on the road.

The hospital is generally surrounded by a "high prison-like wall." At Ghazeepore it is said "*of course* all the buildings generally are "most unsuitable for hospital purposes." Proper ventilation is represented, as at Baroda, as "next to impossible." At Kolapore the rain beats in through the cowls, and "makes the wards so damp that "charcoal has to be used to dry them." The water for drinking may be brought, as at Bangalore, from a tank which receives the whole sewage of the cantonment, and which "just now is not very clean," from which "hundreds of bullock loads of impure matter are removed "year after year, when the tank is low, and the smell from it most "offensive." Or the water may be brought (cholera also being brought with it) from wells into which the said tank drains. The drainage may be by an open ditch into the tank, whence the hospital derives its water. Or the water supply may, perhaps, have to be carried from half a mile off, or even from two miles off, as at Madras. But "no "improvement is required in this respect." (!) The privies are everywhere either "highly offensive," or "not more offensive than the best "of such places usually are in this country." Or the privies are "without seats," and are "kept pure by burning salt in them." "Arrangements admit of improvement."

Scarcely ever is there any provision of separate wards for convalescents; although, in a country whose scourge is dysentery, to leave men

convalescing from dysentery in the same place and under the same circumstances as those suffering from dysentery is just to ensure as far as possible their *not* convalescing. The same may be said of fever and of bowel diseases generally. Convalescents pass their whole 24 hours in bed, except during their time of exercise (*where* they have means of exercise) on elephants, in sick carts, or doolies. They have not even a room to take their meals in, but eat their food upon their knees, sitting on their beds, "possibly with dying men around;" or they are sent to barracks, and put on barrack rations, and "marched out under "a non-commissioned officer morning and evening for exercise."

Where there is no guard house the "men on guard occupy a corner "of the hospital verandah, where they eat, drink, and smoke at their "discretion." No hospitals have dining rooms, although all ought to have them, because of the pest of flies in India. Not one has a day room for men who can leave their beds.

The "sanitary state" is generally represented as "good," although at the same time we are told, as in certain cases, that the hospital is "unfit for accommodation of European patients;" or that "epidemic "disease has appeared in it;" that "sores become erysipelatous;" that, as at Bangalore, "one of the flags" in the floor being removed, "the "smell from the opening was so offensive that" the surgeon was "obliged to run;" that "gangrene and phagedæna have appeared, "when the hospital was crowded;" that "the privy is a nuisance to "one ward;" that the "cesspools are always more or less offensive;" or that the "outhouses are in a very dirty and unwashed condition." At Muttra the contents of the latrines are "carted away every morning "for combustion in one of the many brick kilns which surround the "station, and help to poison the air." At Madras the "sanitary "state" is called "good," and the commander-in-chief himself adds, "if the vile stinking river Kooum were not under the very noses of "the patients." Both cholera and gangrene have appeared at times in the hospital. The latrines are placed to windward "unfortunately;" "tubs only are used." "The privy is washed daily, and charcoal "burned in it." It is called "not offensive," the commander-in-chief again adding, "a year ago it was odiously offensive."

No wonder that it is stated, as at Bangalore, that "sick men are "reluctant to come into hospital from barracks," and that the medical officer does not want "convalescent wards," because he finds it better to send his convalescents to barracks, where they recover faster.

From some hospitals the "impurities" are removed by hand carriage to 30 yards from the hospital. In another, the privy is said to be a "disgrace to the 19th century." One wonders to what century it would be a credit.

At most hospitals the bedsteads are of wood instead of iron, and the men break them to pieces in their "efforts to expel the vermin." As at Ramandroog, where men are sent for their health, "the building "swarms with 'bugs.'" And so of every barrack and hospital where these wooden bedsteads are used. One surgeon complains of the serious injury to his sick occasioned by want of sleep from vermin. The bedding is of hemp or straw, instead of hair. Hair it ought always to be in hospitals, and hair is now the regulation in all Queen's hospitals. It appears from several reports that sheets are not provided except for dysentery and fever; and certainly in no hospital deserving the name should the inspector-general feel himself called on to recommend that "a good mattress, a blanket, *sheets*, and pillow-cases

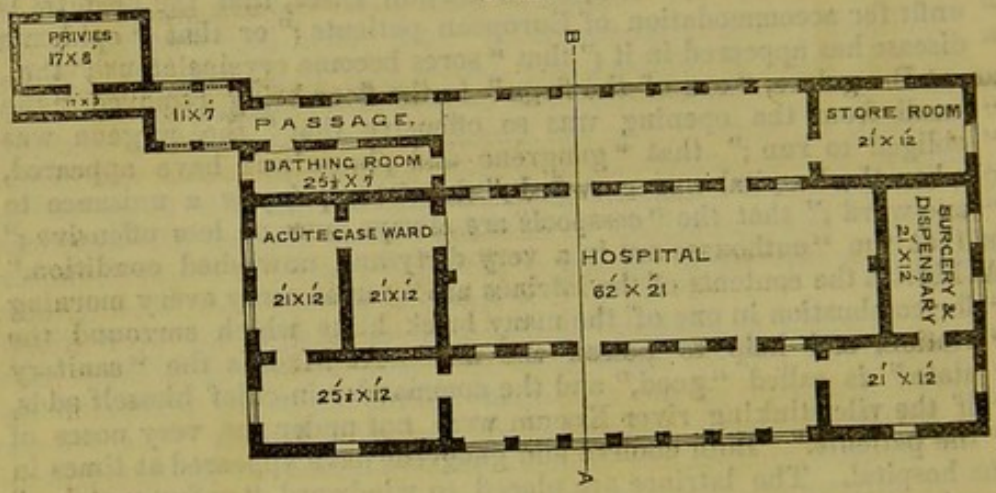
" should be provided for every bed," as does the excellent inspector-general of the Madras Presidency.

Figs. 9, 11 are illustrations of the smaller class of regimental (British) hospitals. Fig. 9 shows the simpler form of construction, a single large ward, partially enclosed by other rooms for sick, all communicating and having a common ventilation, the arrangement good and simple up to a certain point, and then marred in the details. There are privies in place of waterclosets, with covered passages, to conduct foul air to the sick in certain states of the wind. Bangalore gives a reason for " the covered way to the latrines," which we never should have thought of; " it is a covered place for exercise."

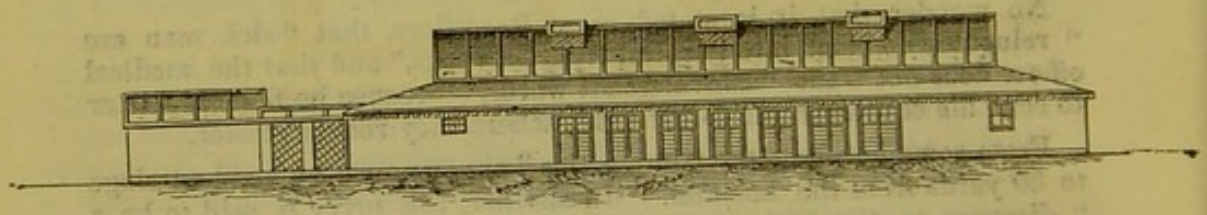
Fig. 9.

HORSE ARTILLERY HOSPITAL. BANGALORE.

Plan.



Elevation.



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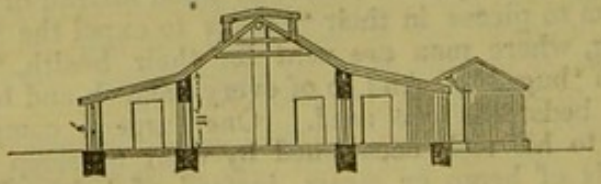


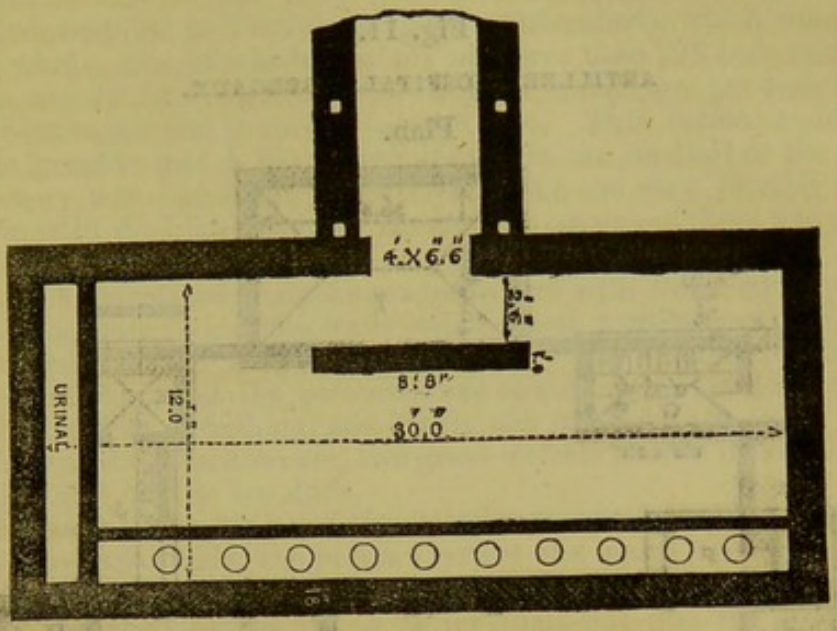
It will be seen that the hospital is entirely destitute of proper ward offices.

Fig. 10 shows the privy arrangements in plan and section. There is no drainage; the contents are carried away by hand.

Fig. 10.

EUROPEAN INFANTRY HOSPITAL PRIVY. BELGAUM.

Plan.



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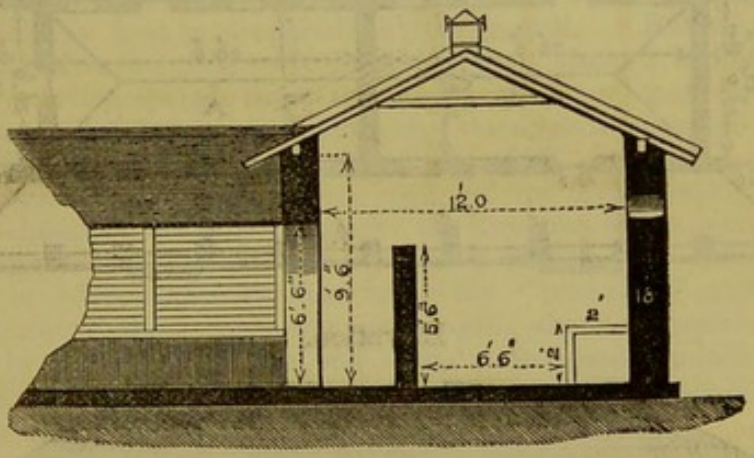


Fig. 11 shows a somewhat better construction of hospital, but there is the same defect in detail.

Either plan might answer for temporary camp purposes, in default of better, but that is all.

Indian hospitals generally, so far as all conveniences and comforts are concerned, appear to be simply camp hospitals ; good, because the best possible for field service, but by no means good or the best possible for permanent stations.

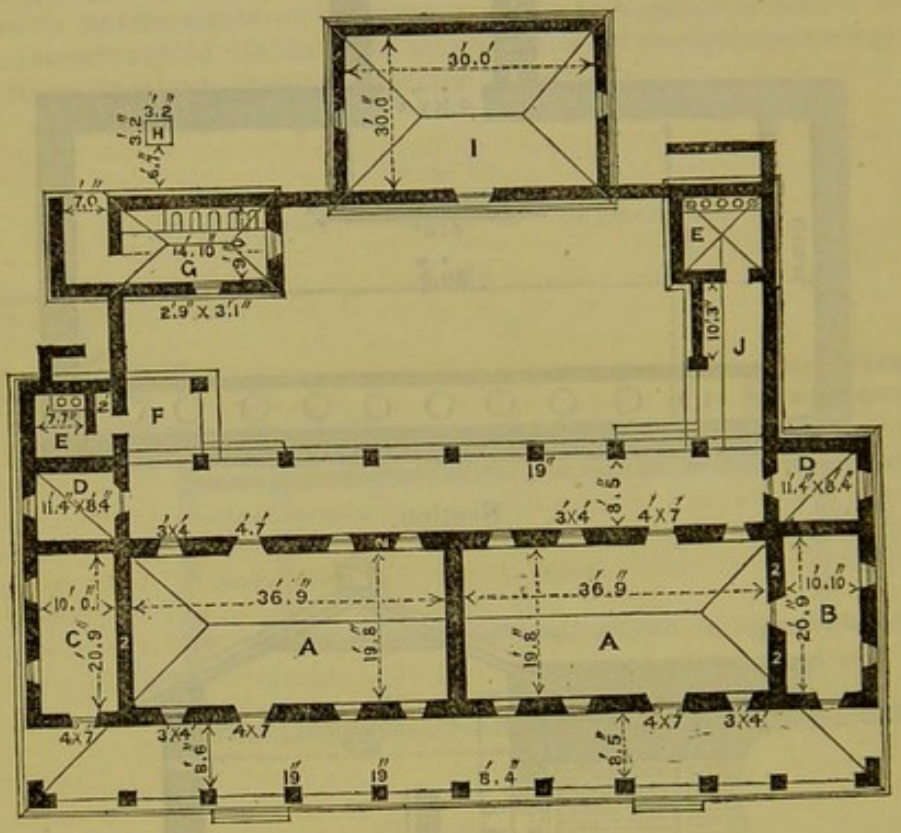
There is no instance, except at Wellington, where the hospital, if on one floor, as is usual, is raised from the ground with any current of air beneath. These hospitals are stated, as at Bangalore, to be "always "damp in wet weather." And often the floor is merely the ground bricked over. Rangoon and Tonghoo live like the beavers, and raise their barracks and hospitals on piles, with free passage for air underneath. The consequence is, that in those jungly swamps they are more healthy than at most other Indian stations where the men sleep close to the ground.

As at Allahabad, Barrackpore, Dinapore, Meerut, Kurrachee, and Secunderabad, vast wards of from 100 to 150 beds, and even up to more than 200 beds, exactly the same as the barrack rooms, are in use.

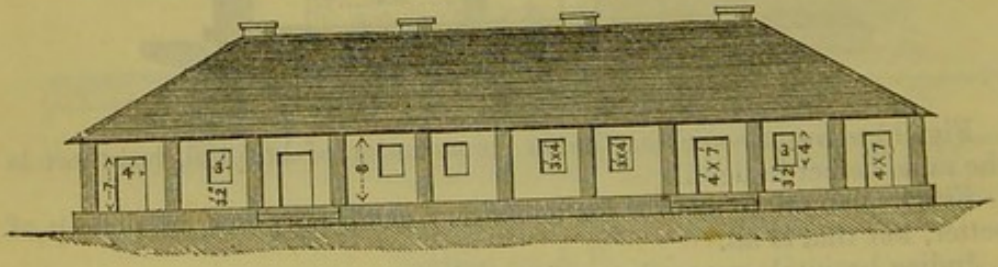
Fig. 11.

ARTILLERY HOSPITAL. BELGAUM.

Plan.



Elevation.



The wards can never be said to be light or airy; "as a general rule "hospitals are badly lighted and gloomy;" doors are more common than windows. And these doors, when closed, leave the ward, if not absolutely dark, yet absolutely dismal and close. Indeed a dark ward must always be a close ward. Or "light enters from a couple of "panes in the doors near the top, and when closed darkness is almost "complete." There is in Indian hospitals hardly a room light enough to perform a surgical operation. And operations, it is stated, have to be performed in verandahs.

The inner verandahs are generally used for sick wherever more room is wanted; the outer ones sometimes cut up for lavatories, destroying what ventilation there is.

The superficial area per bed is almost invariably too small, and the wards almost as invariably too high ; the result to the sick being that, with an apparently sufficient cubic space, the surface overcrowding is excessive. One of the worst examples of this is the recently constructed hospital at Trimulgherry (Secunderabad), which consists of three wards, two of which contain no fewer than 228 beds each ; the wards are 42 feet high, and afford 1,001 cubic feet per bed, but the surface area per bed is only 24 square feet. This surface overcrowding is greater that I have ever seen it in the smallest or the largest temporary war hospitals. Such facts strike one very forcibly in connexion with the high mortality among sick entering these and similar hospitals.

All the defects of barracks reappear, and with worse consequences, in the hospitals ; viz., bad water-supply, bad ventilation, no drainage (Ferozepore says, "drainage not necessary"), offensive latrines, so offensive indeed that the patients have sometimes to leave a particular ward, no means of bathing, and hardly any of cleanliness.

There are besides, however, two grave defects not felt in barracks, but peculiar and fatal to hospitals.

These are the cooking and the attendance. It is in several reports complained that under the present system the cooks (natives or Portuguese) are nothing but "miserable pretenders," because the pay is so small ; that the kitchens are no better than, but just the same as, the barrack kitchens. They are often small open sheds, without chimneys, the smoke finding its way out as it can, and with but few utensils ; sometimes the food is prepared on the ground. "But we are accus- "tomed to this in India." It is added that, though common food is tolerably well prepared, there is nothing whatever that can be called sick cookery, nothing whatever to tempt the appetite or spare the digestion of the sick man, whom the hospital is for.

In hospitals at home, trained cooks of the army hospital corps are now in charge of the cooking, under the direction of the purveyor, who is responsible that the diets are properly cooked. In India the chief quality in native cooks appears to be the "pursuit of cooking under "difficulties ;" their ingenuity in bringing about an *apparently* good result, in a rude and often bad way, is frequently admired by the reporters, as if the end of cooking were "to make a pair of old boots "look like a beefsteak."

In England, where the grass-fed meat is so much better than in India, it is found necessary to put the purveying of meat for hospitals under the charge of the purveyor, for the sake of always obtaining the best quality.

There does not appear to be any provision of this kind in India, where all is under the commissariat.

As to the attendants, they are just the same as would be supplied to idle healthy men. Quantity, it would seem, is supposed to supply quality. In serious cases a "waiting man" is supplied "from the "battalion, who is relieved daily." That is, he goes on guard for twenty-four hours, as in the guard room, so in the sick room. It appears that mounting guard in the sick room is disliked, and the guard sometimes neglects his patient.

As to supposing that any nursing is required, the thing is totally out of the question. There are neither trained orderlies nor female nurses.

A matron is sometimes "sanctioned," but "only for a complete "battalion." If there are fewer sick they must do without. Every

severe case, as has been stated, is allowed to have its comrade to itself in from the ranks—*i.e.*, the case which requires the best nursing is to have the worst nurse. Something more is needed to make a nurse, as well as a surgeon, than mere kindness. Wherever the above comrade-practice is found, we know beforehand that there can be no nursing, no discipline in that hospital, and any amount of drink.

There is generally one hospital serjeant and a "plentiful supply of "ward coolies." The hospital serjeant is for discipline, and under him are 79 coolies and bheesties in cold weather, 240 in hot weather. This for an European corps. The general impression, as regards the native attendants,* is that they are in some sense kind, but "as a rule, "very inattentive;" and when there is any pressure of sick they are "lazy," and "apathetic," and the sick, it need hardly be said, neglected, and "averse to be waited on by them." When at a hill station, as Landour, the hospital serjeant is taken at random from the sick men themselves, sent up for convalescence, it is needless to point out the consequences. This grievance has been repeatedly represented, but in vain.

Nynee Täl has one hospital serjeant, one barber, one orderly, for its attendance.

Lady Canning introduced female nurses at Allahabad, who are mentioned (in the Stational Return of Allahabad) as being a great comfort to the sick. Wherever there are general hospitals there should be female nurses, but only under the organisation laid down by the Medical Regulations of October 1859. It is a great mistake to put down a few women among a parcel of men (orderlies and patients) without exactly defining the women's duties and place.

Lastly, there appears nowhere in India to be provided any means of drying hospital linen, even during the rains. It is often complained that the washing is very bad, and that the native washermen tear the linen, and at one cavalry hospital this keeps two tailors constantly employed in repairing the rents and injuries; for native washing is done by beating the linen against large flat stones or wooden boards.

If the British military hospitals are such, what must be said of those for native troops? Here the patients "diet *themselves*."

As regards construction, where native hospitals have been specially built, they resemble the smaller class of British hospital. One of the most complete of these is shown in Fig. 12, p. 331. There are wards within wards, completely enclosed by other rooms, of which, although there are plenty, not one is suited for ward offices.

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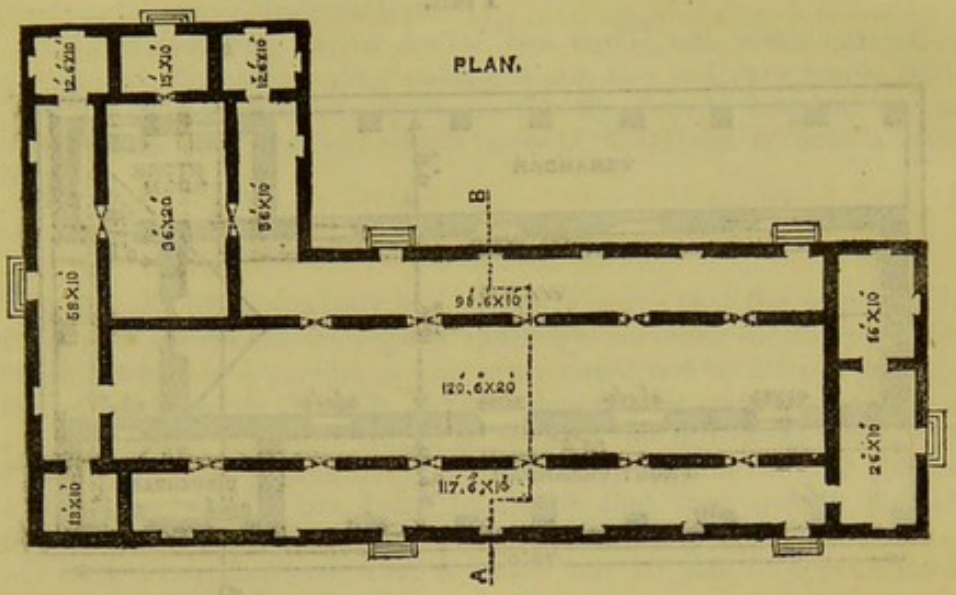
* And here comes in again the difficulty of difference in language. Our men dislike and despise the natives, and are regarded by them in return more as wild beasts than fellow creatures. The native, however, makes much more effort to learn the Briton's language than does the Briton to learn the native's. It is difficult to give an idea of the evil effects of the gross ignorance of all that relates to the country in the ranks of our army in India. The commonest attempt at conversation gives rise to feelings of impatience and irritation, too often followed by personal ill-treatment. Where the Briton is sick, it is, of course, worse.

To enable our soldiers to hold ordinary intercourse with the people among whom their lot is cast, is the first element of an useful and happy life for them in India. Every soldier should be required to learn something of the native language. And a somewhat higher voluntary standard should be fixed, the inducement to attain which should be:—1. A specific pecuniary reward; 2. Eligibility for employment in the various departments of the public service.

Fig. 12.

KURNOOL FORT HOSPITAL. (NATIVE.)



Section on A B.

Elevation.

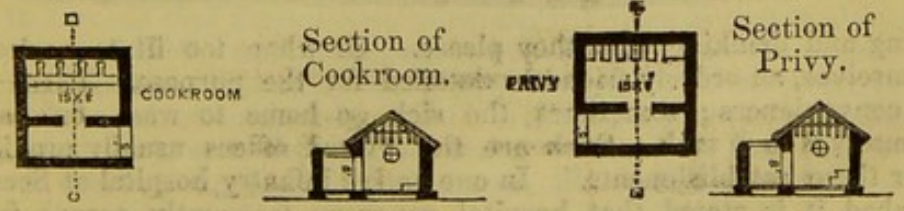


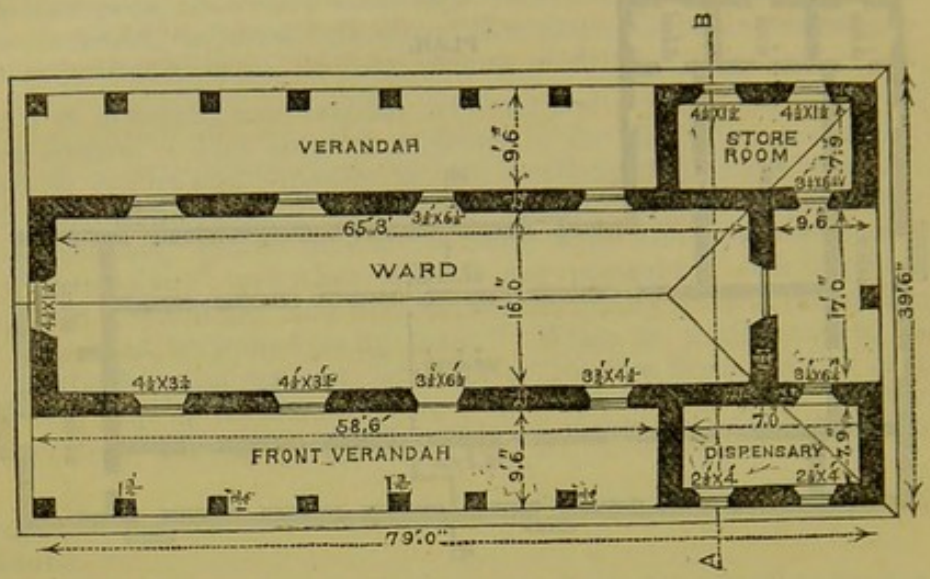
Fig. 13 exhibits hospital construction reduced to its most extreme state of simplicity. It consists of a single ward, with a few square holes on opposite sides, apparently without any glass. No ventilation and no ward offices whatever. But there is a dispensary and store-room exactly where they ought not to be.

But it must not be supposed that native hospitals are all as good as these. They are generally nothing but a shed, perhaps a "gun shed," or a "cattle shed," as at Kolapore, converted into a hospital, where the sick receive nothing but medicine. The patients cook their own diets,

Fig. 13.

NATIVE INFANTRY HOSPITAL. KULLADGHEE.

Plan.



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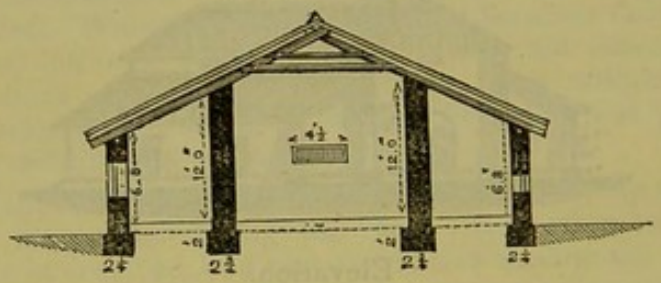

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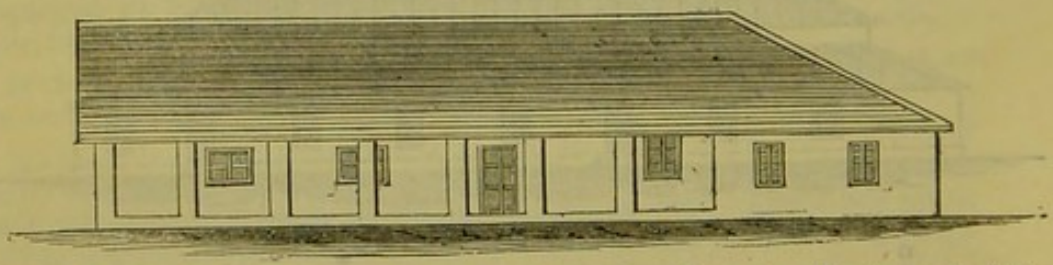


eating and drinking what they please. Or when too ill to cook for themselves, an orderly friend is detailed for the purpose. There are no conveniences; sometimes the sick go home to wash, or bathe themselves in a tank. Such are the "ward offices usually provided "for these establishments." In one native infantry hospital at Secunderabad it is stated that hospital gangrene frequently occurs from overcrowding, from the cachectic state of the patients, *owing to the unhealthy character of their lines*, and from a cesspool in the hospital enclosure, which last is, however, being remedied.

At Rangoon, it is stated that the privies, for native regiments, are built of matting, "which is most objectionable, as allowing the escape "of noxious effluvia." Is it then desired to keep the "noxious "effluvia" *in?*

It is supposed that "caste" prejudices are such as to prevent native hospitals being properly built, and supplied with requisites for sick.

But this has to be proved by giving natives a properly constructed and provided hospital. There are plenty of "caste prejudices" in this country against good hospital construction; but good hospital construction advances nevertheless.

At Loodiana, one native doctor, one coolie, one water carrier, one sweeper, are the attendants "sufficient for the ordinary wants of the "sick." The present arrangements for the female hospital are said to be "sufficient" (which means *none*). (Loodiana is now a native station).

VII. Hill Stations.

Sir Ranald Martin wisely and strongly urges that the whole subject of hill stations should undergo a thorough revision, for the purpose of deciding whether a portion of the army could not be always taking its turn as a reserve on the hills, thus to preserve its stamina.

Children, too, might be reared as well on the hills as at home. One of the native chiefs going over the Lawrence asylum (of 500 children) at Sunnawur, said to Sir John Lawrence that they looked like lion's cubs.

It strikes one, however, that it would not be safe to depend for improvement of the health of troops solely on occupying hill stations, with such an overwhelming amount of evidence as to the bad sanitary state of the stations on the plains, and even of not a few of the hill stations themselves, such as Darjeeling, Landour, Nynee Täl.

"At some hill stations there is malarious fever; others predispose to "diarrhœa." The barracks and hospitals at Kussowlie and Subathoo are defective both in plan and in structure. At Mount Aboo they are "bad barracks," built in a "malarious gully," and the men return suffering from intermittent fever and from scorbutic disease, the result of want of vegetables. Will it be credited that, at one of the two hill stations of the Madras Presidency, the privies are built on the edge of the hill, in order that the natural slope may save us all the trouble of sewerage, the lavatories the same, which are emptied by "upsetting "the tubs" down the hill; and that, at the other, with more than 900 men, the barrack square was an immense swamp for want of drainage? Low fever, from March to May, from which the men have suffered who were sent there for health, is attributed to this, as if it were a meteorological observation. This refers to Wellington on the Neilgherries. Indeed the Neilgherry stations, the best in India, are in great danger of being permanently injured by sanitary neglects.

In fact, all that the hill station evidence proves is that healthy men, put under healthy conditions, will remain healthy, and *vice versâ*.

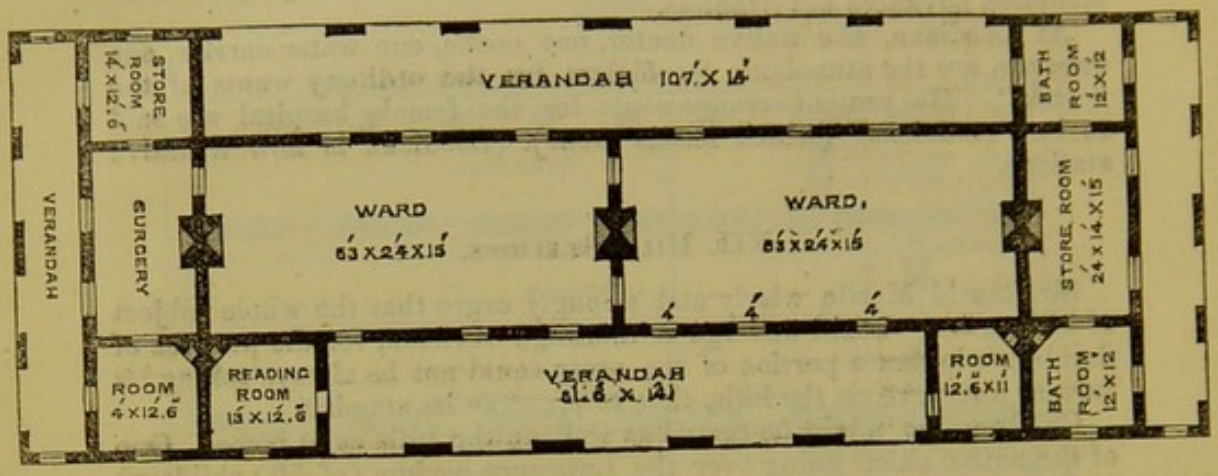
Hill stations, it is said, are highly favourable to troops arriving in *health*, IF lodged in good barracks; are unfavourable in some states of disease. Dry, spacious, well-ventilated barracks, in well-chosen positions, drained, supplied with wholesome water, and out of the way of nuisance and malaria, have been the great want of hill stations. And want of fresh vegetables and of pure water has produced much mischief. In the rains, the water is often loaded with "rotten vegetable matter, "causing diarrhœa." [Is this supposed to supplement the *want* of vegetables?]

High authorities advocate sending certain invalids to sea-side sanitaria.

Hospitals at hill stations appear to be very much on a par with hospitals at plain stations, as far as can be learnt from Fig. 14, which represents the hospital at Darjeeling used for sick of the depôt. The

Fig. 14.

JULLA PUHAR HOSPITAL. DARJEELING.



arrangement is much that of a field hospital, with fire-places to suit the climate. At this hospital an open privy was placed in one corner of the verandah, which compelled the sick to evacuate the ward, and it took five years' writing to get it removed.

Hill climates, judiciously used, would no doubt be of great value. But they are by no means all that is required for the salvation of the Indian army. This must be brought about by sanitary measures everywhere, of which hill stations, if kept in a good sanitary condition (but not if kept in a bad condition), are one. This is the unquestionable result of the evidence.

When our troops went into a notoriously unhealthy district in China, they were not placed on hill stations. They were properly managed, and their sanitary condition provided for; and they had no larger proportion of "constantly sick" than the troops at home.

VIII. Native Lines.

Native troops have no barrack accommodation, no doubt a most excellent thing for their health. They have hutting money (very little), and make their own huts, which are so badly built as to ensure thorough ventilation, being often indeed only open sheds in compartments. But little or no pains are taken to make them put up these huts in any regular order; they are crowded, or rather huddled together, and without drainage of any kind. They are always damp, and the men always sleep in malaria. When they have families the huts are too small, because the hutting money is too small.

Native troops have no rations, and stint themselves of proper food in order to hoard their pay.

They are almost invariably temperate, and have little or no liver disease, whilst the British troops are decimated with it. So far as can be learned from disease statistics, native troops are far more moral than British.

Except schools, no means whatever of instruction, occupation, or amusement are provided for them.

They are, in fact, stipendiaries receiving a day's pay for a day's work, with their uniform, but they are not what we should understand by troops provided for by the State.

With regard to every appliance of civilized life, the tale is even more absolutely *nil* than for British troops. There is absolutely no drainage

or sewerage, no latrines. And the descriptions of what the surrounding country and bazaars are in consequence are absolutely impossible to repeat.

There are no lavatories nor baths.

There are no kitchens.

There is no sanitary police.

At Mangalore, one of the best of the native stations, "surface clean- "sing has hitherto been performed solely by the heavy rains." At Quilon, another, there is (as usual) no drainage, but ruinous buildings, harbouring the dead carcases of animals, and "on one occasion, of an "old woman."

The water supply is of course as bad as, or worse than, at European stations.

At Kherwarrah, in Bengal, the water "has not unfrequently a filthy "taste, and disagreeable organic smell."

The degree to which native troops almost everywhere suffer from guinea worm would alone tell us what the water is. At this same Kherwarrah, one in every six has suffered (for 17 years) from guinea worm.

There is no "conservancy" establishment for cleanliness. At this same large station of Kherwarrah, "this is left very much to the jackal, "vulture, and carrion crow" (beyond the lines). There are patrols to prevent nuisances, "except in specified localities." The lines are kept clean, but the "sweepings are deposited 30 yards to windward."

The most ordinary sanitary precautions are not taken. "Every "family has its own cesspool; dung heaps close to every hut," also holes for ordure. Animals are slaughtered to windward. The offal is thrown to dogs, jackals, and vultures. During the rains the stench from the offal, the increasing accumulation of years, is sometimes dreadful.

The native population is "decidedly unhealthy," from jungle, swampy ground, cramped, damp dwellings (which shelter sheep, goats, and cattle, as well as men), bad food and water, neglected cesspools, middens, exuviæ of men and animals, absence of drainage, opium eating, &c.

What wonder if native troops suffer from quotidian, tertian, quartan, remittent, and typhoid fevers (which alone constitute two-fifths of the sickness and cause one-fourth of the deaths in some places), from acute and chronic dysentery, from sporadic and epidemic cholera, from simple and confluent small-pox, and from acute and chronic rheumatism!

The intelligent medical officer of Kherwarrah imparts a very important secret as to the unhealthiness of Indian stations when he says that none of them have had "fair play" (not even such large British stations as Dumdum, Barrackpore, and Dinapore), owing to the "utter "disregard of the commonest sanitary precautions."

At Cochin, in the Madras Presidency, the water is unfit for use from privy infiltration. Drinking water is brought daily 18 miles. One tank is used for bathing and drinking. The sanitary condition of the bazaar is "as bad as it can possibly be." "Cleanliness is unknown." There is "no drainage." The "streets are used as privies without "hindrance." No regulation for cleanliness is attempted. The old rampart was converted into a ditch, now used as a public privy. Every odd corner is "in the most disgusting condition."

Rajcote, in the Bombay Presidency, might give similar instances of more or less neglect. But it is needless to follow this subject further. Everywhere there is the same ignoring of natural laws, and the same penalties of disease and death.

The hospitals, again, combine all the disadvantages of civilization without any of its advantages. In one place the hospital was so overcrowded that for two years "gangrenous and spreading sores" were "frequent."* Another hospital was so much out of repair that "it "would before long be a ruin" (the best thing that could happen to it). If there is a privy, it is a "small room, with no place in which the "excrement can go to be cleared away." If there is a lavatory or bath, it is "two tubs out of repair" (does that mean that they cannot hold water?) If there is a kitchen, as at Mercara, it is under the same shed as a privy, and cannot be used for the stench. Indeed, the medical officer proposes that it should be turned into a privy. The sick generally cook under the nearest tree, and if unable to do so, a comrade cooks for them under the tree. Linen is washed and dried by caste comrades, or by the patients when not too ill. Each patient brings in his own bedding; generally his own bedstead. "Each "patient defers bathing, according to custom, till he is cured, when he "retires to the nearest well, draws water, and undergoes the bath of "cure," *i.e.*, when he no longer wants it. Every report begs for a bath room.

The general construction of native hospitals has been described under the head of "Hospitals."

IX. Native Towns.

The description given of the native towns is astonishing.

Can it be possible that such a state of things exists after all these years of possession and unlimited authority?

So far as one can judge from the evidence, the sanitary state of entire large cities is as bad as, if not much worse than, was the state of the worst parts of our worst towns before there was any sanitary knowledge in the modern world at all.

What, for instance, is to be thought of the following?

At Bangalore, a station 3,000 feet above the sea, with the climate of a hill station indeed, and quite as healthy as any in Europe, where we have 1,700 men, we have allowed to grow up within our cantonment a native population of half a quarter of a million without any of the arrangements of civilisation whatever. Houses, tanneries, and slaughter-houses are crowded together without any plan. There are no public necessaries. The natives resort to open spaces. The Ulsoor tank, which may be said to be the receptacle of the sewage of the whole place, including our barracks and hospitals, is used for drinking. In dry seasons the tank itself is a great nuisance. Even the wells are poisoned, "owing to the amount of filth percolating into them from "bad drainage." There is a dirt heap at almost every door. In the better houses, where latrines exist, there are wells sunk in the ground within the house, which are closed up when filled and others opened. The filth from the cowhouses flows into open drains. There are no arrangements for stabling the bazaar horses, which with other domestic animals are kept *in the houses*. This bazaar is all close to our own barracks; and it is said that now nothing short of removal of the one or the other will remedy the evil. There is nothing, therefore, to astonish

* Labuan says that its hospital is much larger than "the strength is entitled to," but that "frequently the number of patients far exceeds the number of beds," and the "extra" sick (60 in a strength of 161 !) "have slept on the floor between each bed, "and some in the verandahs."

us in the fact that in this, one of the healthiest stations and climates in the world, the mortality of our European soldiers should have been 129 per 1,000* (including cholera) in one year.

In Hyderabad, not far from our largest Madras station (Secunderabad), all the promoters of zymotic diseases are at work, and cholera, small-pox, diarrhœa, and dysentery are, it is stated, the most common of these.

But the capital of the Madras Presidency is, perhaps, the most astounding. Its river Kooum is a Styx of most offensive effluvia. The air in Black Town and Triplecane is "loaded with mephitic effluvia at night." The atmosphere around Perambore and Vepery is "perfectly poisoned."

At Kamptee, with its 70,000 souls, "all filth is thrown into pits in "the streets (!) of the cantonment." The poorer houses are huddled together without order, on ground intersected by nullahs, making the houses difficult of access. The cesspits, "where accessible," are cleansed every 24 hours. The next information is curious. "Persons "committing nuisances are closely watched and taken up daily." At Jaulnah there are no dung heaps nor cesspits, "outside at least."

The native population around Fort William, Calcutta, is peculiarly unhealthy; fevers of all kinds, cholera and fatal diarrhœa are "remark-"ably prevalent." The causes are "bad overcrowding," "bad drain-"age," foul drains, rank jungle, stagnant water, bad unwholesome drinking water, filth.†

At Ahmednuggur it is acknowledged that almost every epidemic in the cantonment has its origin in the crowded, ill-ventilated, and dirty village of Bhingar (of 3,000 souls). The town itself of Ahmednuggur, with its 36,000 people *and no latrines*, uses "the very boundary of our "camp" for this purpose, and "the smell of ordure is very percep-"tible." At Poona, where there is a city of 80,000 people, three-quarters of a mile off, a bazaar of 27,000, quite close, a village (Wanowrie) 100 yards from officers' lines, where cholera first arose, there is the same story about "no latrines," "conservancy" establishment far too small for the daily removal of filth, and nuisance experienced in barracks from this cause. Belgaum says of its bazaar that there is "no "want of cleanliness," *and* "that the public privies and cesspools are "at times very offensive." The town, with 18,000 people, is between the fort and the camp. It affects the general health of our station from "its bad conservancy." But, again, we are told there is "no want of "cleanliness!"

At Kolapore, "*one* sweeper is maintained by Government" (for the bazaar), who collects the filth and throws it into a nullah, 400 yards from camp, which is also the public necessary; "two peons" prevent nuisance being committed in camp "from 4 to 10 a.m. daily." At Bombay, with a town of from 400,000 to 600,000 souls, there is a municipal commission, with sanitary powers, and the result of its practical labours is as follows:—Native houses generally in a filthy condition; much ordure within precincts of buildings, where it has been accumulating *for years;* native town proverbially unhealthy; nuisance, from wind blowing over it, experienced in Fort George and town barracks; washermen's tanks particularly obnoxious; site of slaughter-house as bad as can well be; sea breeze cut off by bazaars, &c. &c.

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* Dr. Macpherson's report on Madras Presidency, Dec. 27, 1860.

† A view of the jackals cleaning Calcutta has recently appeared as a woodcut in a popular paper. [I should like to introduce it here.]

Dung heaps are a "never-failing condition of native life in India."

At Baroda, the military hospital is close to a nullah used as a "necessary" by the natives, and as a "receptacle for the filth of the whole "station." When cholera occurred, the hospital had to be evacuated. And yet it is added, with great *naïveté*, the "sanitary recommendations "of the medical officers are always attended to."

At Dinapore the native towns are "disgracefully filthy," with "holes "near all native houses."

At Cawnpore there is overcrowding and want of ventilation, with all manner of filth.

At Peshawur the streets are dirty, the houses densely crowded and ill ventilated. The population suffers from a "severe and fatal" typhoid remittent fever, which rises to an "epidemic" in certain districts, also from epidemic small-pox, &c. &c.

At Ghazeepore, in the latter months of 1859, there was a "fearful" fatality from "fever," due to a total want of sanitary arrangements.

At Berhampore there seems to be scarcely any epidemic which the native population has *not*. Among the causes: "holes full of stagnant "foul water, close to almost every house, forming the usual cesspool "of the neighbourhood." "Utter neglect of ventilation and of all "sanitary measures."

At Hazareebaugh cholera and small-pox are the "most common and "fatal epidemics."

Only the presentable flowers are here. The stational reports are a garden to which those who doubt the truth of this representation, taken as a whole, and think it merely true as to particular facts, are again referred.

The stational reports generally state the native populations to be "healthy," or "remarkably healthy," and then give a list of every disease that flesh, *under defective civilisation*, is heir to, to which they are subject endemically or epidemically. What must be the state of health of the natives when "unhealthy"?

One remark, or rather inference, viz. native "caste" prejudices appear to have been made the excuse for European laziness, as far as regards our sanitary and hospital neglects of the natives. Recent railroad experience is a striking proof that "caste," in their minds, is no bar to inter-communication in arrangements tending to their benefit.

Sir C. Trevelyan justly says that a good sanitary state of the military force cannot be secured without making similar arrangements for the populations settled in and around the military cantonments; that sanitary reform must be generally introduced into India for the civil as well as the military portion of the community; that now is the time, for not only has the subject been worked out by actual experiment in England, but the improved financial state of India, the increased influx of Europeans, especially of engineers and mechanics, and the powers of local legislation lately conferred upon the subordinate governments, have given facilities which never existed before. The sanitary arrangements for towns will be conducted by municipal bodies, for the creation of which there is already a very good Act of the Government of India.

The mere passing of such an Act presupposes the impotence of "caste" prejudices; and nobody who understands the relation of bazaars and native towns to garrisons and cantonments can fail to see that the sanitary improvement of the Indian army involves the sanitary improvement and the advance of civilisation in India, a work before

which "caste" prejudices, and many other prejudices, will have to give way.

X. Absolute Perfection of Causes of Disease.

Our experience at home as to the results of sanitary improvement on the health of the army affords every reason to expect a very great improvement in the health of the Indian army, if proper sanitary measures be carried out. And it would require very strong evidence indeed to convince the people of this country that the epidemics which have devastated India arise from any other causes than those which the stational returns and the evidence prove to exist in what one may call a state of absolute perfection in Indian towns, but which have been removed with entire success in this country.

XI. Soldiers' Wives.

"Leave to marry" in the British army means that those only who marry with consent of the Commanding Officer have a claim to quarters in barracks. The proportion of quarters allowed by regulation at home is 6 married men per company of 100, in addition to married serjeants. When going to India, 12 married couples per 100 men, together with a proportionate increase of wives of serjeants, are allowed to go with the regiment, a number which high authorities consider too small. There is a general opinion that the proportion of married people allowed to go to India should be raised. The question is mainly one of sea transport and barrack accommodation, neither of which would be very costly as compared with the benefits to health and discipline which all agree would result from increasing the number of married men, always the steadiest, most temperate, and best behaved in the regiment.

Throughout India, however, there is better provision of "married "quarters" generally than on home stations. At most places they are reported as "sufficient," at some "insufficient," at others "very bad," and at a few there are none. Where they are insufficient or non-existent, the "married quarters" are men's barrack rooms or huts, divided off by curtains or partitions. Only at a few places are married people placed in barrack-rooms with unmarried soldiers, still this practice does exist. One of the consequences of "allowing" marriage in the army is certainly that decent healthy quarters should be "allowed" too. No time should be lost, for this is especially necessary in India.

In the matter of soldiers' wives there are two instances of striking contrasts (each happened during the Mutiny); one, the destruction by dysentery of 64 wives and 166 children of British soldiers at Dumdum; the other, a request made to and complied with by Sir John Lawrence from an officer of a native regiment of guides regarding the native wives. "Mind you look after these women carefully, and do not let them be in "distress; several of their husbands, men of rank, have been killed." The request was loyally fulfilled, and as loyally appreciated by the men.

At Dumdum 554 women and 770 children were crowded together without care or supervision, and the proportion which fell victims to intemperance, immorality, filth, and foul air was more than six times, in either case, the ordinary mortality of women and children in Bengal. The fathers and husbands were fighting or dead in our battles. This

massacre killed as many as it is supposed fell by the hands of the mutineers.

It is singular that in no one part of the Dumdum report does the slightest allusion occur to this tragedy, making one think that it cannot be an isolated case. And it appears to have arisen solely from the absence of any regulation as to the care of soldiers' wives and children in the husbands' and fathers' absence. Families go to India, and as long as the regiment remains fixed things may go on pretty well, provided there are decent separate quarters and a careful, kindly commanding officer. But send the regiment on active service, and there is no way of caring for the families. They take their chance under circumstances where they *cannot* help themselves. Or they are all huddled together, as at Dumdum, with this result, that while the husbands were punishing the murderers of English women and children in the upper provinces, their own wives and children were being destroyed in vast numbers for want of care. Why?—Could it not be made a necessary part of army arrangements to appoint a "picked" married officer to act as guardian over these women and children, to see to their comfort and conduct, to their being properly lodged and cared for? The manner of providing for them out of their husbands' pay is a matter of detail easily settled. If only anyone will take the trouble to do it, the thing can be done. But more than this, it should be made matter of regulation throughout the whole service. There should be personal responsibility somewhere. At Dumdum nobody was held responsible, and nobody was punished for the result. If one-tenth of the calamity had happened in England, there would have been coroners' inquests over and over again, and public opinion, if not law, would have punished some one. At Dumdum the inquiry took place after the destruction of human life had been going on for months.

Sir John Lawrence expresses forcibly his practical opinion that there should be a "system" treating the "men as so many children," in binding them to "remit" money for their families, but also providing guardianship for those families when the "regiment is going on ser-"vice," and so averting the "terrible results" of "abandoning the "wives."

Why cannot what was done for the Sikhs by Sir John Lawrence be done by regulation and on system for our own country people?

There are shocking illustrations of how soldiers' wives and children fare when the men are on foreign service, and how a man does not become a better soldier for knowing that his country does not care for his wife and children while he is risking his life for his country. To the extent to which marriage is allowed in the army should all its necessary consequences be acted out.

But so far from this being done, the principle everywhere has been the reverse. Even as regards illness, in some notorious instances soldiers' wives have expressed (and justly) the strongest indignation that Government took more care of prostitutes in illness than it did of honest wives; that Government will pay to cure the prostitute to go on with her horrid trade, which destroys their husbands, and will not pay to cure the wives and children, or to make the married quarters more comfortable; and it is true, although not so applicable to India, where there are female hospitals.

Some of these hospitals, as at Kurrachee and Deesa, Lucknow, Raneegunge, and Ferozepore, appear to be very complete, with female attendants. In the Madras Presidency they are too often, as at Bangalore, Trichinopoly, and Kamptee, merely men's wards appropriated

to women, and justly stated to be "objectionable in every way." Elsewhere they are rather bare. Indeed, as at Baroda, Kirkee, Poona, Darjeeling, the sick women and children "have to be attended at their "own quarters," either because "there is no matron," or because the "ward is too small," or &c. &c. Curiously enough, it is generally stated that the "present arrangement is conducive to comfort." What arrangement? Of having no matron? While it is added, that a lying-in ward and a matron are "much wanted." At Darjeeling the women and children are treated in their own quarters, which "would "be satisfactory enough if the married quarters were not so dark and "damp as they are." Sometimes it is said that "the arrangements "are quite equal to those for the men."

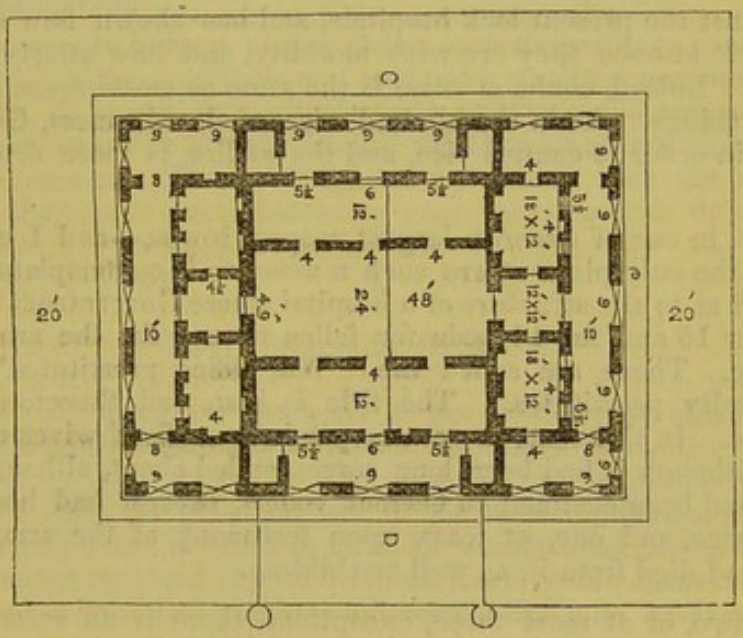
The construction of these hospitals appears to be the same as that of small regimental hospitals.

The following plan and section of a female hospital at Meean Meer

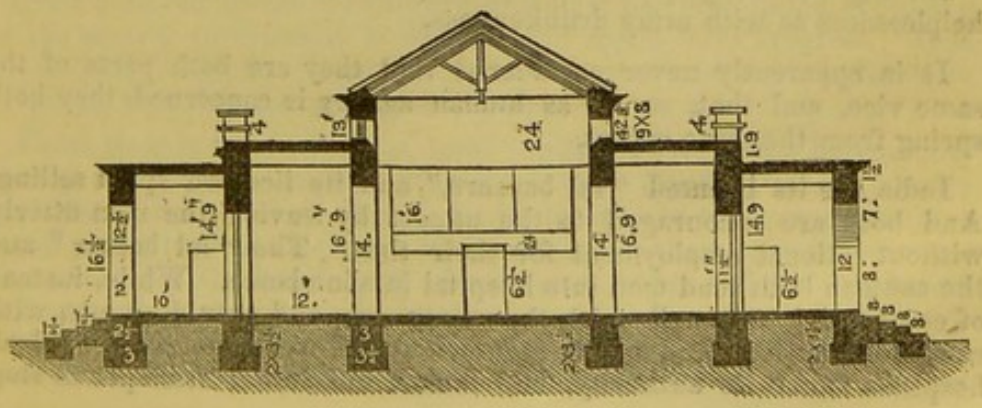
Fig. 15.

FEMALE HOSPITAL. MEEAN MEER.

Plan.



Section on C. D.



(one of the most recently built in India) shows that they require quite as much structural improvement. It is a nest of rooms within rooms; and the same may be said of it that one of our engineers said of the Pacha's new fort on the Dardanelles, that "he would be much safer "outside of it."

But whatever defects there may be in the hospital accommodation for soldiers' wives and families in India, at least prostitution is not encouraged, and its immorality systematically palliated by lock hospitals on any large scale, although recent attempts have been made to extend them. Lock hospitals, alas! exist—exist, I mean, and are advocated and supported on the principle of restoring the vicious to go on with their vice, the only institution I am aware of for this purpose. (Prisons and lock hospitals in England at least aspire to reclaim the vicious.) And lock hospitals and police regulation are, alas! sometimes recommended, just as if they could do any good. At Secunderabad, it is said, a lock hospital has been in existence, with these "excellent results," viz. that 20 per cent. of admissions into (military) hospital are from the disease engendered by vice, which is five times as much as exists among the native troops. On the other hand, the enlightened medical officer of Kurrachee has entered a striking protest against the present lock hospitals, and has shown how utterly incompatible at once they are with morality, and how utterly useless in practice. Indeed, common sense is the same as moral sense in these as in other things. As in the kindred vice of drunkenness, Government licenses in order to control vice, and the soldier is more drunken than before.

Lately, in one of our own largest seaport towns,—and I understand it is not the only place where such a measure is contemplated,—I was consulted as to the structure of a hospital where Government was going to pay for 15 and for 10 beds for fallen women for the army and for the navy. These are called the "War Office prostitutes" and the "Admiralty prostitutes." The title is just, and therefore the less agreeable. In this same town a hospital for soldiers' wives only lately exists, although it had been long corresponded about, although several women had been confined in barrack rooms, several had had fever in consequence, and one, at least, upon testimony of the army medical officer, had died from it, as well as children.

With two, or at most three, exceptions, there is no accommodation for sick women and children at any home station.

As regards army prostitution, there is, as I have said, the same helplessness as with army drunkenness.

It is apparently never considered that they are both parts of the same vice, and that, so far as human agency is concerned, they both spring from the same causes.

India has its licensed "lal bazaars," and its licensed spirit selling. And both are encouraged to the utmost by leaving the men utterly without rational employment for their time. The "lal bazaar" and the canteen both send men into hospital in abundance. While, instead of confronting both evils with the strong arm, and providing men with useful occupations and manly amusements, Government sets up lock hospitals under its authority, and makes ineffectual attempts to stop

drunkenness by keeping the supply of drink, as far as it can, in its own hands, and so encouraging the evil by its own authority. The authority of Government is avouched for both evils. So long as this is the case, they will extend and flourish, and the taxpayers in India and England will have to bear the cost.

XII. Statistics.

All that can be said under this head is, that the statistical abstracts of sickness and mortality for the European troops of the Indian army afford no data of sufficient accuracy to enable us to judge of the sanitary state of the troops, while they are defective in some most important data required for estimating the exact sanitary condition of the stations. Practically, these statistics are very much in the same condition as were those for Queen's troops before recent improvements were introduced. The facts may be in existence, but there are no means of rendering them easily accessible. The question of mortality and efficiency is one of even greater importance now than it was formerly, seeing that the whole British army must pass through India in the course of its service.

The only way to keep a proper check over the sanitary condition of stations is to lay their sickness and mortality statistics annually before Parliament. This can be easily done by adopting the new statistical methods and forms at present in use for Queen's troops at home and on foreign service. These should be introduced over the whole of India, and the results published every year, together with those of the army at home.

XIII. Sanitary Service.

In times past there has been no proper sanitary service in India. No doubt there has been more or less of cleanliness ; because wherever Englishmen go they attend to this in one way or other. Otherwise there is just the same neglect of civilized appliances, of water supply, drainage, &c., as used to exist in unimproved towns at home, notwithstanding repeated representations made by Sir Ranald Martin, and by other enlightened professional men. In India, as at home, no good will be done unless it be made some competent person's express business to look to these things.

Even with our habits of self-government, it has been found necessary for the central government to step in and assist local progress. It is certainly of far greater importance for the government of India to do so, seeing that there is no local self-government at all.

There is, it is true, a kind of local sanitary government by commissions at the seats of the three presidencies, the result of whose labours has hitherto been that no one of those three large and populous cities has as yet arrived at the degree of civilization in their sanitary arrangements at which the worst parts of our worst towns had arrived, before sanitary reform sprang up in England at all. Bombay, it is true, has a better water supply ; but it has no drainage. Calcutta is being drained ; but it has no water supply. Two of the seats of Government

have thus each one half of a sanitary improvement, which halves ought never to be separated. Madras has neither. As to barracks and cantonments, it is quite evident that both sanitary medical officer and sanitary engineer need to "be abroad."

I am, my Lord,
Your faithful servant,
FLORENCE NIGHTINGALE.

Right Hon. Lord Stanley, M.P.,
President of the Royal Commission on the
Sanitary State of the Indian Army.

Nov. 21, 1862.

ABSTRACT OF SANITARY DETAILS

IN

REPORTS FROM PRINCIPAL MILITARY STATIONS IN INDIA.

Bengal Presidency.

Topography. —Mortality.

Returns have been made from 35 stations in *Bengal* presidency, where there is accommodation for British troops. Of these stations 34 are included in the following abstract.

The stations least elevated above the sea level are *Fort William* and, farther up the river, *Dumdum*, which are only 18 feet above the sea. At these two stations there is accommodation for above 3,000 troops, in positions so low that the tide washes into all the neighbouring ditches, and more or less saturates the subsoil with water.

Along the valley of the *Ganges*, from *Fort William* as far as *Lucknow*, and close upon the river, there are upwards of 15,000 British troops located at elevations above the sea level varying from 80 feet to 368 feet. With scarcely an exception, these stations are on the same level as the surrounding country. *Allahabad* is partly 40 feet above the Ganges, but a third of the station is actually below the river. *Berhampore* is 3 feet below the level of the river Bhagirutty, which skirts the station.

The N.W. stations are on higher ground; *Ferozepore*, the lowest of them, is 720 feet above the sea level, and *Rawul Pindee* is 1,500 feet.

Between these two elevations there is accommodation for above 20,000 troops.

Hazareebaugh, one of the best stations of the Presidency, is situated on a table land in Lower Bengal, 1,900 feet above the sea. There are above 1,100 troops barracked at this station. The cantonment site has the advantage of being 200 feet above the level of the adjacent country.

Meerut and *Agra* are, the one 100, the other 50 feet, above the surrounding levels; but with these exceptions the stations generally are little, if at all, raised above the adjacent country.

There are four returns from hill stations at elevations from 7,000 to 7,800 feet above the level of the sea, but the accommodation provided at these is for not more than 1,200 men. The highest of these stations is *Murree*. They are all situated in the Himalayas, and are at present used as sanitaria.

There are 11 considerable stations on the banks of the river Ganges.

The subsoil is chiefly alluvium and clay, more or less wet or marshy during the rains. The surrounding country is generally undulating or flat, and in several instances the means of natural drainage are deficient.

The majority of the N.W. stations are situated on flat sandy ground, with more or less alluvium mixed with limestone nodules or conglomerate. In some districts the underlying rock is sandstone. The country round several of these stations is imperfectly cultivated, and there is not much wood for shade. The hill stations rest on mountain masses of gneiss, sandstone, and limestone. They are generally on ridges, with steep slopes or ravines falling from them, and have ample means of natural drainage and water supply, but they are subject to very heavy rain-fall and great dampness at certain seasons.

TOPOGRAPHY. —MORTALITY.

Stations.	Elevation above		Accommodation for British Troops.	Actual Occupation.	Mortality per 1000 per annum (Queen's) British Infantry.*		Topographical Remarks.
	Sea. Feet.	Country. Feet.			Total.	Miasmatic Diseases.	
Fort William	18	0	1,465		102·35	77·83	Plain; swampy; alluvial; sand; clay; numerous tanks.
Dumdum	18	0	1,649		76·57	64·79	Alluvium and clay; swampy during rains.
Barrackpore	23	0	1,080				Flat, alluvial; marshy jungle, on bank of Hooghly; alluvium, with sand and clay.
Berhampore	76½	−3	1,196				Alluvial; many water holes; 3 feet below river level.
Hazareebaugh	1,900	200	1,120	1,080			Undulating; dry; gravel and loam on clay.
Raneegunge	370	0	1,424	1,129			Undulating; sandy; swampy; gravel and sandstone.
Dinapore	212	+	910		62·55	48·02	On bank of Ganges; flat; flooded during rain.
Ghazeepore		0	830	848	47·03	42·08	On bank of Ganges; alluvium with calcareous conglomerate.
Benares	270	0	1,377	876			Undulating; alluvial; resting on calcareous conglomerate.
Allahabad	368	40	4,280	2,515	122·75	82·34	At junction of Ganges and Jumna; sandy; country under water from July to November; clay subsoil.
Cawnpore		0	1,402		91·48	71·58	Flat; sandy; arid; no jungle; alluvium on kunkur; 60 feet above Ganges.
Lucknow	360	+	124		169·29	148·73	Site open.
Jhansi	700		189				Rocky; hilly; barren; ravines; granite and quartz subsoil.
Morar Gwalior	800	0	1,594				On bank of river Morar; stony, barren hills; open, undulating country, argillaceous soil; kunkur subsoil.
Agra	800	50	1,776	1,400	42·48	20·58	Flat; dry; sandy; ravines; unhealthy; alluvium; clay; sand; lime.
Muttra			424	400	37·26	23·45	Subsoil kunkur; flat; sandy; dry; close to Jumna; water lies on surface.
Delhi	800	0		959			Rocky; ravines; flat; dry; sandy; some swamp; jungle and wood.
Meerut	900	100	4,227		45·12	30·41	Sandy; flat; dry; loam on calcareous conglomerate.
Nynee Tal	7,609	1,200	840	740			Mountainous; limestone.
Roorkee		+	630	487			Dry sandy plain.
Landour	7,000	4,000	200	228	60·71	29·01	Mountainous.
Umballa	1,050	0	2,162	2,162	55·24	38·27	Flat; sandy; cultivated.
Ferozepore	720	0	948	1,148	56·05	36·77	3½ miles from Sutlej; flat; sterile; sand and clay.
Umritsur	900	0	1,650	620			Flat; sandy, with clay; kunkur.
Lahore / Mean Meer	1,128	8		2,214	81·42	58·23	Flat; arid plain; alluvial clay; loam and sand; last on surface.
Scalkote	900	0	1,200		26·79	13·17	Flat; alluvial; sandy subsoil.
Rawul Pindee	1,500	+	200		28·86	14·29	Alluvial plain; loam and clay resting on limestone conglomerate.

* From the Statistics of Sickness and Mortality among Queen's Troops, folio Report, vol. I:

Topography.—Mortality.

Stations.	Elevation above Sea. Feet.	Elevation above Country. Feet.	Accommodation for British Troops.	Actual Occupation.	Mortality per 1000 per annum (Queen's) British Infantry.* Total.	Mortality per 1000 per annum (Queen's) British Infantry.* Miasmatic Diseases.	Topographical Remarks.
Murree - -	7,800	2,500			91·76	47·06	Mountainous; sandstone indurated red clay, and black soil.
Peshawur -	1,056	68		2,651	61·23	41·81	Flat; partially irrigated.
Loodiana -	900	0					Sandy plains, with clay cultivated.
Jullundur -	937	12		1,200	36·62	21·33	Flat; sandy; hollows with water.
Chunar - -	250	—	268				Close to Ganges; sandy; swampy from overflow; sandstone.
Jubbulpore -	1,250	+	1,000	827			Hilly and flat; jungle and water in vicinity; cultivated in parts; sand; black cotton soil, with black trap or laterite.
Darjeeling -	7,000	6,000	120		38·95	23·37	Mountainous; gneiss rock: subsoil clay, covered by sand and vegetable soil; forest at a short distance.

Stations of British Troops.

Fort William.

1. Climate.—Mean maximum temperature varies from 71°·4 in December to 93°·8 in May; mean minimum varies from 59°·3 in December to 80°·8 in June; mean daily range varies from 7°·5 in August to 18°·1 in December; mean sun temperature from 124°·3 in December to 135°·9 in October. Mean rainfall 64 inches; temperature high; atmosphere generally moist, at times very offensive and impure from malaria and effluvia near Calcutta, less so in Fort William. Healthy months, November to March; unhealthy, April, May, September, October, when prevailing diseases are fevers, intermittent, remittent, cholera, small-pox, dysentery. Climate affects health and constitution of troops in garrison. Change from cold to heat, extreme humidity, drying of country after rain, precede or accompany miasmatic disease.

2. Diseases of Native Population.—Native population comparatively unhealthy. Prevailing diseases, intermittent, remittent, typhoid fevers; cholera; dysentery; small-pox; enlarged spleen, and fatal diarrhœa, remarkably prevalent. *Causes.*—Rank jungle; filth; stagnant water; damp; foul drains; bad drainage; bad, unwholesome, brackish drinking water; bad overcrowding; dirt and bad diet.

3. Diseases of European Troops.—Fevers, intermittent, quotidian, quartan, tertian, double tertian, remittent, continued; dysentery, acute, chronic; cholera, bilious, spasmodic; small-pox, benign, confluent; rheumatism, acute, chronic. These diseases occasion from 60 to 65 per cent. of total sick, and from 75 to 80 per cent. of total deaths. Causes stated to be exposure and drink, bad drainage and water supply. Soldiers' duties do not predispose to disease. About five per cent. of the sick in hospital are venereal cases, "might "be lessened by police regulation." Hepatic disease nine per cent. of total sick. Cause high and variable temperature and spirituous liquors. Moderation in diet, cleanliness, mental amusement, and exercise recommended as prophylactics.

4. Bazaars and Native Towns.—Fort William is surrounded on all sides by large and populous villages. Estimated population of Calcutta, 500,000. Water and drainage bad. Rainfall flows slowly away or evaporates, causing humidity: filth, foul drains, stagnant water, jungle, and nuisances.

5. Barrack Construction.—Fort William, 18 feet above sea level, 67 miles distant from the sea, contains five barracks occupied by soldiers.

* From the Statistics of Sickness and Mortality among Queen's Troops, folio Report, vol. I.

Fort William.

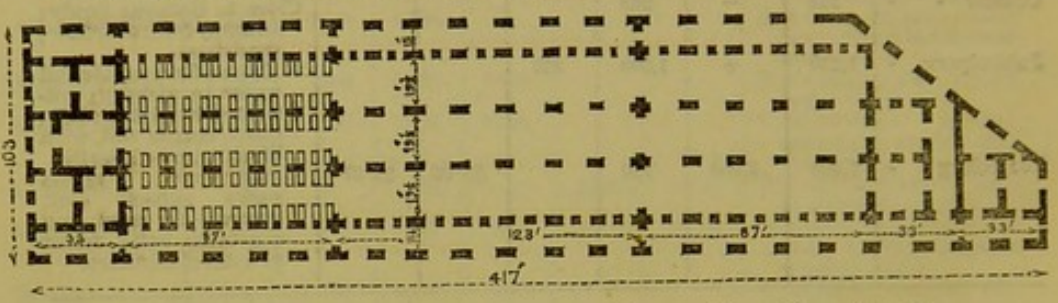
Site.—Comparatively open, but ramparts, being 25 feet high, interfere with free ventilation; temperature considerably raised by reflected sun heat.

(1.) *Dalhousie barracks.*—36 rooms for 631 non-commissioned officers and men; have held 900. There are 3 floors of barrack rooms, over a basement. Each floor consists of 3 long parallel rooms, from 81½ to 124 feet long, 64½ feet wide, 19 feet high, giving from 1,500 to 1,600 cubic feet, and from 79 to 85 square feet per man. The long rooms communicate by arches; each has two rows of beds; thus there are six rows of beds between the opposite windows, 64½ feet distant.

The following Fig. 1 is a ground plan of a floor of the barrack, showing an arrangement of cots for 306 men in one room.

Fig. 1.—Plan of First Story Dalhousie Barrack, Fort William.

Showing the arrangement of cots in a portion so as to accommodate 900 men in all.



It is stated that this accommodation may be considered "perfect."

(2.) *South barrack.*—Thirteen rooms; 210 non-commissioned officers and men; at from 1,183 to 1,938 cubic feet, and from 64 to 108 square feet per man; length of rooms, 77¾ to 98¼ feet; breadth, 19¾ feet; height, 18½ feet; from 16 to 26 men per room; these rooms are on second story.

(3.) *North barracks.*—Thirty-six rooms; 210 non-commissioned officers and men; 900 to 1,800 cubic feet per man; 50 to 100 square feet per man; 28 rooms at 7 men each; 1 room at 36 men; which last room is in length, 239 feet; width, 15 feet; height, 18 feet.

(4.) *West barracks.*—Bomb-proof. Nine rooms; 300 men; "one-half would "be too many;" 1,404 cubic feet per man; 140 square feet per man; centre room, length 200 feet, width 18 feet, height 10 feet.

(5.) *Queen's barracks.*—156 rooms for 108 married men and 12 non-commissioned officers, formed by dividing a large room by wooden bulk heads, 8 feet high; each family room being 22 feet long, 12 feet wide, 18 feet high.

In all the barracks, the windows are on opposite sides, with verandahs, in which many men place their cots in hot weather; doors, one-third panel, two-thirds Venetian.

Floors, brick on edge, covered with Chunar flags.

Materials, best burnt brick, set in lime mortar; roof, solid brick, with concrete terrace; basements never used as barracks.

Iron cots.

6. Married Quarters.—Separate rooms in Queen's barracks for 120 families. Serjeants have separate rooms at the end of all barracks.

7. Ventilation of Barracks.—By numerous doors, 12 to 13 feet high and 6 feet apart, and openings at the ceiling. Cooling by punkahs. These arrangements, with the height of wards, 17 to 20 feet, said to be "quite "sufficient" for purity of air by night and day.

8. Drainage.—By open masonry drains to wells opposite gateways, from which sewage is carried to level of main ditch; drainage bad, and requires manual labour. Fluid refuse swept away by garrison sweepers and water carriers with aid of fire engine; much of it evaporates; outlet a foul ditch. Bomb proof barracks damp.

9. Water Supply.—Supply principally from river and tanks, partly from rain and wells, the last brackish and unwholesome. Water for cooking, drinking, &c. is carried from a tank on the glacis (filled by surface drainage), at a cost of 134*l.* per annum. This tank is kept "perfectly clean," and is "generally "free from foul drainage and surface impurities," but from careless habits of bheesties, water sometimes taken from nearer and impurer sources. Many city

tanks in a most filthy condition, producing malaria. Amount of water for troops sufficient for drinking and washing, not for bathing. Proposed to supply Fort William from the Hooghly, the filtered water of which contains 9·4 grains of solid impurities in 40 ozs. (above 29 grs. per gallon). This supply said to be very perfect, but the river water is not good enough for use for 6 weeks annually. *Fort William.*

10. Ablution and Bath Rooms.—Lavatories at end of barracks on each story; stone floors, with raised masonry basin-stands; water flows off to drain surrounding the building; plunge-baths much wanted (included in future plans).

11. Intemperance.—Troops about as temperate as at other stations. Seven trials for habitual drunkenness in 8th regiment in three months. In 5th Fusiliers 2 per cent. habitual drunkards. But average of habitual drunkards in European regiments in this country not less than 15 per cent.

8th regiment, direct admissions	from intemperance,	to total admissions,	1 in 114.
5th Fusiliers, do.	,,	,,	2 in 100.
8th regiment, indirect admissions	,,	,,	1 in 11.
5th Fusiliers, do.	,,	,,	17 in 100.

Seven regiments in Madras 1849.

	Punished. per 1,000.	Admitted per 1,000.	Died per 1,000.
Teetotallers - -	236·9	1,308·9	11·11
Temperate - -	587·2	1,415·9	23·15
Intemperate - -	1,709·8	2,148·6	44·58

Drunkenness punished as an offence. Spirits sold in regimental canteens, average daily consumption 1½ drams per man; not issued before dinner. To men in health spirits decidedly injurious in India. They are the curse of the European soldier in India. Beer in moderation greatly preferable. Would be most beneficial to health to suppress spirits altogether, allowing a ration of beer from the canteen instead, also to substitute tea, coffee, &c.

12. Instruction and Recreation.—There are at this station one ball court and eight skittle alleys; two regimental schools and a garrison school; one garrison library and regimental libraries; a theatre and a gymnasium. There are no day rooms, no soldiers' clubs, no gardens, no workshops. Cricket, foot-ball, and quoits are played morning and evening. Present means said to be "sufficient." Savings banks decidedly most advantageous. Ground floors of barracks and verandahs afford ample shade for recreation.

13. Hill Stations.—No experience. But consider hill climates beneficial to the weak and to men suffering from functional disease; but useless, or even hurtful, to organic disease. Troops on return to plains not more liable to fevers. At Kussowlie, Subathoo, Simla, and Dugshai, "white purging" prevails, often causing serious losses in the regiments. Croup and diphtheria also occur. Natives suffer from typhoid fever. "Troops should be located on hills, "with short periods of service on plains." Best elevations 4,000 to 8,000 feet, with good drainage, thorough ventilation, space, and freedom from local causes of disease.

14. Hospitals.—*Site.*—Three-quarters of a mile from Fort; partly open; site, "healthy for Calcutta."

Water supply from tank.

Drainage.—Imperfect; mere open surface drains, discharging into a foul open ditch, receiving the sewage of the gaol and hospital, 100 yards from the wards; a great nuisance.

Construction.—Sick only on upper floors; roof water carried off by surface drains; walls, brick and mortar; verandahs, inner one frequently used for sick; buildings, 2 and 3 floors high; constructed in 1795.

Accommodation.—Forty-two wards for 420 beds, at from 1,630 to 1,927 cubic feet, and from 78 to 181 square feet per bed. Numerous windows open to the floor.

Ventilation by windows, doors, jhilmils; sufficient. A constant current through the wards and no closeness. Punkahs are used.

Fort William.

Cleansing.—Walls and ceilings cleansed and whitewashed once yearly.

Latrines 61 feet from wards, reached by covered passage; ordinary close stools emptied when used.

Lavatory and baths.—Hot and cold baths in each wing, besides ordinary bathing room.

Hospital washing done in compound.

Bedding.—Wooden or iron cots, the latter preferable.

Storage.—Sufficient at ordinary times.

Cooking.—Common native cooking places and an open fire for roasting.

Attendance.—Hospital serjeant, two European ward masters, and native ward coolies. Proposed to introduce European female nurses, one to every 25 patients, to whom it would be "more grateful."

Sanitary state.—"As good as circumstances will allow."

Convalescents.—Special wards "superfluous," as "soldiers are generally kept "in hospital till reported fit for duty."

Female hospital.—Buildings not very airy, but arrangements "most "satisfactory."

Dumdum.

1. Climate.—No proper instruments. No observations. Temperature, 1° or 2° lower than Calcutta. Climate very moist. Thick mist nearly every morning for a month before hot season. Climate not ordinarily unhealthy, with proper precautions; healthiest months, November to January; unhealthiest, June to August, when cholera, dysentery, and fevers prevail.

2. Diseases of Native Population.—Sickly in hot weather. Prevailing diseases, small-pox; cholera, in hot weather; fever with spleen disease, at end of rains; cholera endemic in the district. *Causes.*—"Defect of vaccina-"tion," (of small-pox); lowness and dampness of native huts; bad food and vegetables; putrid fish.

3. Diseases of Troops. — Fevers, remittent, intermittent, continued; dysentery, acute, chronic; cholera; rheumatism; these occasion 57 per cent. of total treated; 99 per cent. of total deaths. *Causes.*—Season and rainfall. Keeping from sun and from spirits best preventive of hepatic disease. Little venereal disease. Lock hospitals recommended.

4. Bazaars and Native Towns.—Bazaar not crowded. "Nothing to complain of" as to drainage, ventilation, cleanliness, or water supply. A cart and six sweepers kept. Native houses generally pretty clean.

5. Barrack Construction.—*Site.*—Tolerably open; very low.

Accommodation.—1,649 non-commissioned officers and men; 31 to 209 men per room; latter room is 469 feet by 28 feet by 18 feet; 1,000 to 1,270 cubic feet per man; 64 to 71 square feet per man.

Verandahs on both sides; one often used for sleeping, leading inevitably to outbreak of sickness.

Materials.—Solid masonry and iron; leak badly.

Floors.—Chunar stones, raised 3 feet, with passage of air beneath.

Roofs.—Totally insufficient. There should be wooden floors.

Wooden cots.

6. Married Quarters.—None. Either a barrack is divided into temporary quarters, or if under the same roof with unmarried men, the quarters are completely separated from them.

7. Ventilation of Barracks.—By opposite doors and windows. Circular holes close to ceiling, and ventilating windows in upper floors; holes along roof of verandah, covered with earthenware pots. Ventilation quite insufficient, especially at night, when crowded. Cooling by punkahs.

8. Drainage.—No sewers. Open drains 6 feet from buildings. Interval being a tile platform. Drainage passes by main drain into salt water marsh. Surface water and drainage from lavatories not efficiently carried away. Drainage from cookhouses, latrines, and urinals removed daily in carts, and buried in pits outside station. Cesspits, 2½ feet in diameter, 5 feet deep. Lower floors of barracks damp, particularly in rainy season.

9. Water Supply.—Water from wells and open tanks; quantity abundant; generally clear; sensible properties good. In 40 ozs. there are:—*Well water:* Solid residue, 6·6 grains. Silica, ·8 grains; earthy carbonates, 1·8 grains; alkaline chlorides, 0·8; alkaline sulphates, 0·3; carbonates and organic matter,

Dumdum.

2·9. *Tank water:* Solid residue, 2·8 grains. Silica, ·2 grains; earthy carbonates, 2·0; alkaline chlorides, alkaline sulphates, carbonates, and organic matter, 0·6. Tank water should be filtered. Raised and distributed for use by bheesties, in leathern bags.

10. Ablution and Bath Rooms.—Lavatories with metal basins, supplied with water from stop-cocks. No baths.

11. Intemperance.—Soldiers usually temperate. Out of 850 admissions, 2 were from delirium tremens; 10 ebrietas. Spirits sold in canteen. Drugged spirits in bazaar. Spirits injurious to health, most prejudicial to discipline. Would be beneficial to suppress sale in canteens, and to permit only beer, coffee, tea, &c. to be sold, with exceptions in special cases. Permit no native grog shops within 4 miles of cantonment.

12. Instruction and Recreation.—Fives courts and several skittle grounds. A school; no library, nor reading room; no day room, nor soldiers' club; no gardens, no workshops, nor gymnasia; no theatre, except a barrack room, occasionally used. Present means "totally insufficient for occupying "the men." Great success lately attended the opening of a small museum, illustrated by lectures showing "that soldiers are ready to avail themselves "of any means of rational amusement in the evening, in preference to spending "all their time in the canteen." No sufficient shade.

13. Hospitals.—*Site.*—Generally healthy.

Water supply.—Wholesome, but not abundant.

Drainage.—By surface drains. Lavatory water conveyed away with roof water. Other foul water flows into a pit and is carried away daily.

Construction.—One-storied: raised on brick arcnes 3 feet above ground, with free ventilation beneath. Masonry walls. One hospital iron-framed. Verandahs used for sick when centre wards full.

Accommodation.—Main hospital, 20 wards; iron-framed hospital, 7 wards; native hospital, 6 wards; female hospital, 9 wards; total beds, 390, at from 1,072 to 1,637 cubic feet and 78 square feet per bed.

Ventilation.—Full benefit of prevailing winds. Numerous doors and windows. Ventilating skylights. Punkahs for cooling.

Cleansing.—Limewashing once a year, or on requisition.

Latrines.—Usual construction. Contents removed by cart every morning.

Lavatory.—Metal basins. Water laid on. Hot, warm, and shower baths.

Hospital washing.—Done by dhobies.

Storage.—Sufficient.

Bedding.—Wooden bedsteads. Iron bedsteads, with coir mattresses, are to be introduced.

Cooking.—Usual arrangements. Cooks not highly paid, and of the worst description.

Attendance.—Usual arrangements. When sick men cannot quit their beds, one or two comrades are allowed to attend them.

Sanitary state.—Satisfactory.

Convalescents.—No wards. Not required. Walks, but no shade. Exercise given by an ambulance bullock waggon.

Female hospital.—One with 23 beds. Female attendants but no matron. An experienced nurse, capable of assisting at confinements, required.

Barrackpore.

1. Climate.—No proper instruments. Temperature in hot season, 82° to 104° in shade; in rains, 80° to 96°; in cold season, 54° to 80°. Climate moist, warm, little variation; moderately healthy. Evenings in hot weather sultry and oppressive. Heavy dews in mornings in cold weather. August to October unhealthiest. Diarrhœa, dysentery, cholera, fevers, remittent and intermittent, then prevail.

2. Diseases of Native Population.—Moderately healthy. Intermittents; dysentery, acute and chronic; spleen; epidemic cholera; elephantiasis.

3. Diseases of Troops.—Hepatic disease 2 per cent. of cases. *Causes.*—Alternations of temperature, intemperance, exposure. Prophylactics: use of flannel, temperance in eating and drinking, avoiding exposure. Syphilis, 13 per cent. of total sick; Lock hospitals not nearly of so much use as in Europe. Prevailing diseases, fevers, continued, remittent, intermittent (most frequent); dysentery (frequent and dangerous); cholera; small-pox, rare; rheumatism, frequent. These diseases occasion about 38 per cent. of admissions, and 75 per cent. of deaths. Most frequent in great and close heat. *Causes.*—Crowding

Barrackpore.

in barracks, bad ventilation, intemperance in eating and drinking, exposure, want of occupation.

4. Bazaars and Native Towns.—Bazaar clean, tolerably drained and ventilated; not overcrowded; water supply from tank; establishment of sweepers paid by tax on occupiers.

5. Barrack Construction.—*Site.*—Much vegetation in neighbourhood; not interfering materially with ventilation.

Accommodation.—Eighty-five soldiers' rooms; 30 non-commissioned officers' rooms; for 960 single and 120 married men; 1,260 to 1,702 cubic feet per man; 60 to 95 square feet per man.

Verandahs, 10 to 12 feet wide; not used for sleeping.

Materials.—Brick and mortar; pillars on iron frames; mud cement.

Flooring.—Tiles over brick, 2 to 3 feet above ground; no passage of air beneath.

Bedsteads, wooden.

6. Barrack Ventilation.—Partly by open wall, 3 feet under roof into verandahs; partly by ventilators in roof; generally sufficient.

7. Drainage.—Only surface drainage. Filth of all kinds removed by carts.

8. Water Supply.—From tanks principally, wells, and river; tanks often polluted by decayed leaves from trees; without taste or smell. *Analysis of imperial quart.—Tank water:* Solid residue, 2·7 grains. Earthy carbonates, 1·02 grains; silica, ·38; saline and soluble matter, chiefly chlorides, sulphates, and carbonates, 1·3 grains. *Well water:* Total solid residue, 12 grains. Earthy carbonates, with sulphates, 6·46 grains; silica, ·44; soluble saline matters, chiefly chlorides and carbonates, 5·1 grains. Both waters contain a little organic matter. [Tank water contains 10·8 grains, and well water 48 grains per gallon of impurity, besides organic matter.] Raised and distributed in skins.

9. Ablution and Bath Rooms.—Wash-house for each barrack. No bath.

10. Intemperance.—Liquor too easily procured. A good deal of intemperance. A rather large number of confirmed drunkards; 14 to 15 per cent. of admissions directly from drink. Spirits injurious to health. If entirely abolished among European troops, and dietary improved, &c., mortality would be "extraordinarily diminished." Malt liquors, although not essential, not injurious. Decidedly beneficial to suppress spirits, though it would excite discontent at first. Men should have employment, recreation, good tea, coffee, milk, more variety of food and cooking.

11. Instruction and Recreation.—Companies' skittle alleys, a school, library, and reading room, used as a day room. Present means not sufficient. No gardens, no workshops. The following are required:—Fives courts, a theatre, gymnasia, swimming baths, public reading of good biographies, travels, novels, &c. Trades of various kinds, such as clothing, accoutrements, barrack furniture, watch making, printing, paper making, baking. Savings' banks should be connected with workshops. No sufficient shade.

12. Hospitals.—*Site* open; generally healthy.

Water supply from tank close to hospital; abundant and generally wholesome.

Drainage by open masonry; drains to river; "sufficient."

Construction.—An iron-framed building with verandah; one immense hall, 411 feet long, 38½ feet wide, and 23 feet 8 inches high. Verandahs. Building on one floor 3 or 4 feet high, and planked over.

Accommodation, 150 beds, all in one ward (60 beds on each side, 30 beds down the middle), at 1,809 cubic feet and 86 square feet per bed.

Ventilation by doors and openings in ridge; "sufficient."

Cleansing.—Limewashing annually, or oftener.

Latrines of usual construction. Contents removed daily.

Lavatory attached to hospital. Two bath rooms with two baths in each. Earthen dishes used for ablution.

Hospital washing by dhobies.

Storage insufficient. Bedding and clothing partly kept in verandahs, and injured by wet or damp (since remedied).

Bedding.—Wooden bedsteads; tow mattresses.

Cooking "sufficient."

Attendance.—Usual establishment. Comrades allowed in serious cases.

Barrackpore.

Sanitary state good, but more accommodation in the way of store rooms and small wards required.

Convalescents.—No wards; not needed. No provision for exercise, except verandahs. Weakly men taken out on elephants.

Female hospital, none. "Certainly desirable."

Berhampore.

1. Climate.—Mean maximum varies from 75° in December to 100° in June. Mean minimum, from 51° in January to 78° in December. Mean temperature, 64° in January to 87° in June. Mean daily range, from 13° in August and September to 30° in March. Rainfall, 39·75 inches. Climate damp. Frequent fogs during cold weather, until 9 or 10 a.m. Heat very oppressive April to beginning of June. N.W. winds healthy. Healthy, December to February. Unhealthy, August to November. Fevers intermittent, remittent, spleen, diarrhœa, dysentery, liver and rheumatic affections then prevail. Endemic disease, with rapid prostration of strength, accompanies damp air and powerful sun acting on vegetable matter.

2. Diseases of Native Population.—Unhealthy. Prevailing diseases, rheumatism; "fevers of all types;" diseases of bowels; liver; spleen; lungs; cholera; small-pox. *Causes.*—Damp climate; rank vegetation; "holes full of stagnant foul water close to almost every house; forming the usual cesspool of the neighbourhood." "Utter neglect of ventilation and of all sanitary measures;" low level of country.

3. Diseases of Troops.—Fevers, quotidian, tertian, quartan, remittent, continued; dysentery; cholera; rheumatism. *Causes.*—Humidity and heat, acting on decaying vegetable matter; want of drainage; want of cleanliness and ventilation in bazaars; stagnant water. Hepatic disease, 10 per cent. of admissions. *Causes.*—Intemperate habits; exposure to sun; malaria. Syphilis, 16 per cent. of admissions. No precaution can be suggested. Lock hospitals unnecessary.

4. Bazaars and Native Towns.—Town contiguous to station. Nothing can be worse than sanitary condition of bazaars; conservancy establishment far too limited. Native houses dirty in the extreme; dungheaps or deep holes full of stagnant water close to them, the common cesspit of the house. Nuisance in barracks from holes full of dirty water and filth, and from elephant and bullock sheds. Bad drainage.

5. Barrack Construction.—*Site.*—Surrounded by jheels and wet ground; barracks built in square; ventilation impeded by bazaars, &c.; three upper-storied and eight lower-roomed barracks.

Accommodation.—One European and one native infantry regiment; 24 to 100 men per room; cubic feet per man, 1,037 to 1,314; square feet per man, 70 to 82; four rooms in each upper-roomed barrack used for dining and recreation; no windows, only Venetian doors.

Materials.—Brick and mortar; flat terraced roofs.

Floors, terraced and tiled, 1½ feet above ground; no ventilation below.

Bedsteads.—Iron and wood; mattresses, hemp.

6. Married Quarters.—Accommodation for 120 married men and families.

7. Barrack Ventilation.—Roof ventilation by holes 2½ feet in diameter; covered with ventilating zumlahs; sufficient. Punkahs for cooling.

8. Drainage.—Open concave drains, 2 to 3 feet broad, 6 inches deep; washed daily and sprinkled with lime; outlet into a large tank close to barracks. All lower barrack rooms damp, from being 1½ feet below river level. Contents of privies carried to holes a mile from barracks; only one cart allowed; quite insufficient for a square mile of cantonment. Vicinity abounds in jheels and foul ditches, with putrid water.

9. Water Supply.—Water from river, wells, and tanks; chiefly from wells for European troops; supply almost unlimited; well water tolerably pure, when filtered through charcoal; no chemical analysis. Raised in leathern buckets by hand labour.

10. Ablution and Bath Rooms.—Each barrack has lavatories for men and women; water carried from tanks and wells in goat skins, poured into cisterns, and conveyed into rooms by pipes with cocks; drainage into surface drains.

11. Intemperance.—Soldiers usually temperate; 1 in 120 admissions produced directly, 1 in 10 indirectly, by drink. Among temperate men, 45½ per

Berhampore.

cent. of sickness; 34¼ per cent. of crime. Among drunkards, 52½ per cent. of sickness; 65¾ per cent. of crime. Spirits injurious, except to old soldiers, who have indulged in them. Sale should be abolished in bazaars, and allowed under restrictions in canteen. Would be beneficial to substitute beer, except to those who have long indulged in spirits. Well-conducted coffee and reading rooms should be established at a distance from canteens.

12. Instruction and Recreation.—Five ball courts, two skittle grounds. Library and reading rooms, but neither lighted at night. A theatre is being fitted up. No schools, no day rooms, no soldiers' gardens, no workshops, no gymnasia, no sufficient shade. Men restricted to barracks from 8 a.m. to 5½ p.m. Savings banks advantageous.

13. Hill Stations.—Strongly approves. Mild diarrhœa prevails; attributed to the drinking water. Considers service in plains, with change to hills, the best.

14. Hospitals.—*Site* objectionable; close to dry river bed; high walls impede ventilation, except in upper floor.

Water supply from wells; requires filtration for use.

Drainage.—Very imperfect, only one small drain communicating with a cesspool, 30 yards from hospital; not sufficient fall to carry off rain water speedily.

Construction.—Brick and mortar; terraced roof; two floors.

Accommodation.—Seven wards, 156 beds; 1,257 to 1,287 cubic feet; 64 to 66 square feet per bed.

Ventilation.—Venetian doors in lower story; glazed doors in upper; openings above doors; punkahs; ventilation "sufficient."

Cleansing.—Limewashing twice a year.

Latrines.—Thirty-six yards from hospital; iron pans 2 feet deep, with metal covers; drainage very imperfect; native hospital has a cesspool.

Lavatory.—Baked earthen basins; bath-house with hot and cold baths, out of repair; wooden tubs used; very inconvenient.

Hospital washing done at a distance.

Storage sufficient.

Bedding.—Wooden bedsteads; mattress and pillows of hemp; sheets and country blankets.

Cooking.—Usual kitchen utensils; "sufficient."

Attendance.—Hospital serjeant and orderlies from regiment; trained orderlies would be greatly preferable.

Sanitary state.—No sick on lower floor at present; upper floor satisfactory; improved drainage and baths required.

Convalescents.—No wards; only the verandahs; no shaded walks or seats.

Female hospital.—One ward set apart for sick; same medicines and comforts supplied as for men; one anna a day deducted as stoppage.

Hazareebaugh.

1. Climate.—No proper instruments; only a thermometer. Mean temperature, 64°·85 in December, 87°·3 in July. Rainfall, 72½ inches. Climate, medium between Bengal and upper provinces. Air free of dust. Temperature, 8° or 10° cooler than most Indian stations. Climate variable, but excellently adapted for European troops, especially recruits. Flannel belts required in rainy season. Air cool, sun hot. September to November unhealthy; typhoid, remittent, and intermittent fevers, and bowel complaints then prevail. December to April healthy.

2. Diseases of Native Population.—Natives, a poor puny race. General health, average. Prevalent diseases, fevers, intermittent; spleen. Cholera, small-pox; most common and fatal epidemics. *Causes.*—Jungle; malaria; rice cultivation; poverty; insufficient food.

3. Diseases of Troops.—Fevers, continued, remittent, intermittent; dysentery; diarrhœa; rheumatism; these occasion 48 per cent. of total admissions, and 60 per cent. of total deaths. *Causes.*—Powerful sun; humidity; rank vegetation; malaria from decaying vegetable matter; listlessness of mind. Hepatitis not common. One fourth of cases in hospital are syphilitic. Inspection (not by army medical officers) beneficial but immoral. Would refuse to sanction it. Not much gained by Lock hospitals. They would not use them, unless compelled.

4. Bazars and Native Towns.—Town, 5 to 6,000 inhabitants. Bazaar open, well ventilated, clean. Sufficient water supply. No more than ordinary

crowding. Good natural drainage. No latrines, and much nuisance along one road in consequence.

5. Barrack Construction.—*Site.*—Open, freely ventilated.

Accommodation.—960 single men, 120 married; 10 temporary barracks, 300 feet by 20 feet by 18 feet; 100 men each barrack, at 1,080 cubic feet per man; 63 square feet per man.

Five temporary barracks, 24 families each; 4,500 cubic feet per family; 200 square feet per family; no windows, only doors and fan-lights.

Verandahs, 10 feet wide.

Materials.—Foundation and plinth of burnt bricks in mortar. *Superstructure.*—Burnt and sun-dried bricks in mud.

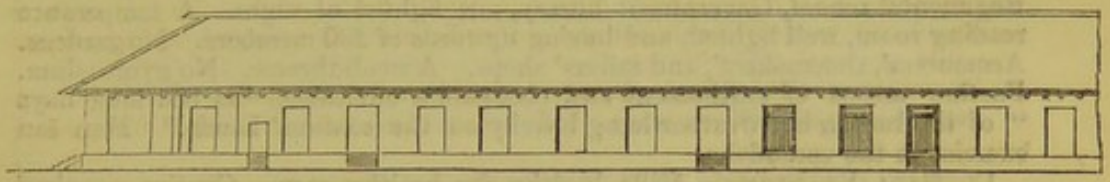
Roofs.—Tiled over thatch.

Floors.—Brick and stone terraced, 2 feet above ground; no air beneath.

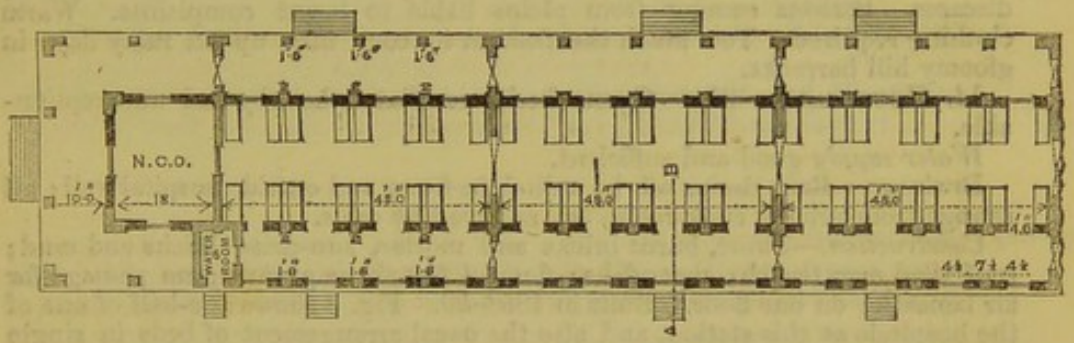
Iron hooped cots.

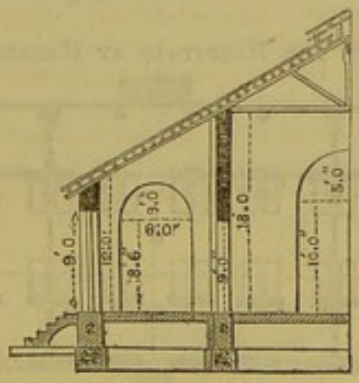
Fig. 2 is a plan of one half of a single verandahed barrack at Hazareebaugh, showing the usual construction of this class of barrack.

Fig. 2.—Standard Plan of the Barracks at Hazareebaugh.



Half Front Elevation.





Section on A B.

6. Married Quarters.—Accommodation ample.

7. Ventilation of Barracks.—Ridge ventilation running the whole length. Fanlights on pivots over each door; sufficient because one or more doors are kept open. Cooling by punkahs from April till September.

8. Drainage.—Drainage from washhouse removed by covered drain. Surface drainage vanishes rapidly. Refuse from privies, urinals, &c. carted 2 miles away.

9. Water Supply.—From wells and tanks; in some wells the water has a slightly saline taste, in others it is pure; no chemical analysis, but tests show presence of silicic, phosphoric, hydrochloric, and carbonic acids; hardness, 4·5; tank water alkaline; deposited copiously on standing; contains organic matter in considerable quantity. All water should be filtered. Drawn by bullocks.

Hazareebaugh.

10. Ablution and Bath Rooms.—Ten double lavatories, one single; basins supplied by water-taps from cistern, and drained away by covered drain into main drain.

11. Intemperance.—Soldiers as a body temperate; one-third of diseases and one-half of crimes, directly or indirectly from drink; but no statistics. Each man may purchase $\frac{1}{20}$ gallon of spirits per day. Actual consumption in 1859, 6¼ gallons per man per year. Spirits decidedly injurious to health, and not conducive to efficiency or discipline. Abolish altogether sale of spirits in canteen and bazaar. Injurious even in moderation. Long cherished idea as to their necessity for the British soldier thoroughly exploded. A man who drinks tea or coffee will do more work than a dram drinker, though considered sober. It is an error to sell spirits in canteen to prevent men obtaining worse spirits in bazaars. It creates craving to be satisfied elsewhere. Selling rum in canteen is an unmitigated curse to a regiment, destructive alike to health and discipline. Even malt liquor not necessary to health in India, but not injurious, or less so than spirits. It will be a "happy day" when only coffee, tea, lemonade, &c. are drunk.

12. Instruction and Recreation.—Ball court and skittle grounds. Regimental school, Government library, not lighted at night. A temperance reading room, well lighted, and having upwards of 200 members. No gardens. Armourers', shoemakers', and tailors' shops. A small theatre. No gymnasium. Further means of amusement and occupation advisable, "as the long days of the Indian hot weather hang heavily on the soldiers' hands." Men can exercise in the verandahs.

13. Hill Stations.—Hills healthy for healthy men. Caution required for invalids. Quite unsuited to many diseases. Favourable to most lung diseases. Persons coming from plains liable to bowel complaints. Warm clothing required. Too much the fashion to coop men up on rainy days in gloomy hill barracks.

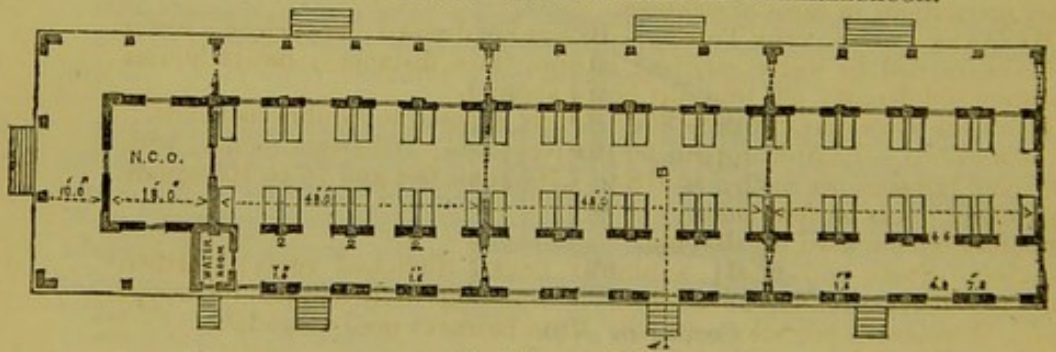
14. Hospitals.—*Site.*—Open, freely ventilated, healthy and unexceptionable.

Water supply good and sufficient.

Drainage.—Rain drains off by a ditch in front and outside hospital wall; all sewage from privies, cook-room, &c. removed by carts.

Construction.—Stone, burnt bricks and mortar, sun-dried bricks and mud; roof tiled over thatch; verandahs; floors 4 feet above ground; no passage for air beneath; on one floor. Built in 1858–59. Fig. 3 shows one-half of one of the hospitals at this station, and also the usual arrangement of beds in single verandahed hospitals.

Fig. 3.—Standard Plan of the Hospitals at Hazareebaugh.



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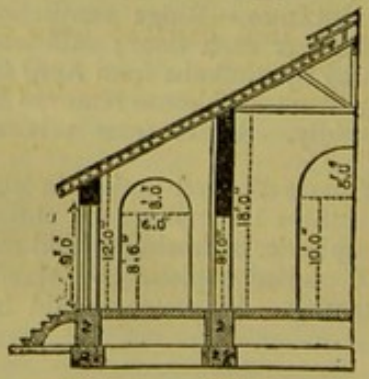


Hazareebaugh.

Accommodation.—Six wards, 96 beds; 1,080 cubic feet, 60 square feet per bed.

Ventilation.—Hospital broadside to wind; wooden doors; no windows except fan-lights over doors; roof ventilators; glass doors and Venetians suggested; cooling by punkahs; other means unnecessary; warming by open fire-places.

Cleansing.—Limewashing once a year, or oftener on requisition.

Latrines.—On standard plan; contents removed 2 miles from barracks lime and charcoal used.

Lavatory.—Water laid on to each basin; dirty water drained away by covered drains; "sufficient;" no baths; "sick wash in the basins of the "lavatory, and can always afterwards, if they please, get a skinfull of water "thrown over them by the water-carriers."

Hospital washing done by dhobies (5 allowed for a corps) at a distance.

Storage not dry enough; stores at present in the female hospital.

Bedding.—Iron-hooped cots; mattresses seldom sufficiently thick to prevent the patients feeling the hoops; pillows stuffed with country hemp; sheets and blankets.

Cooking.—Ordinary Indian arrangements; pay too small to secure services of cooks "with even moderate pretensions to the name;" plain roasting, boiling, &c., all that can be expected. "No delicacy of any kind, likely to tempt "the capricious appetite of a sick man, could be prepared by these miserable "pretenders."

Attendance.—Usual arrangements; "European nurses, professionally trained, "might be most advantageously introduced into the hospitals in this country."

Sanitary state "very good," "but more light would be an advantage."

Convalescents.—No wards; convalescents sent back to barracks; no shaded walks, except verandahs; elephants used for exercising.

Female hospital.—One; 5 wards; 80 beds; 1,080 cubic feet and 60 square feet per bed; female attendants; arrangements very good and satisfactory.

Raneegunge.

1. Climate.—No proper instruments. No satisfactory observations. Highest mean maximum temperature, 96½° in May. Highest mean temperature, 91° in May. Climate generally healthy, but subject to heavy dust storms.

2. Diseases of Native Population.—Generally healthy. Prevailing diseases, fevers, cholera in outbreaks. *Causes.*—Mode of living; neglect of all sanitary precautions in cases of sickness.

3. Bazaars and Native Towns.—Bazaar not drained; kept clean; water from tanks, carried by water carriers; latrines (at a distance); native houses near station indifferent; pits and dirt heaps abound.

4. Barrack Construction.—*Site.*—Open, exposed to salubrious winds.

Accommodation.—1,120 European, 500 native troops; 20 barrack rooms; with 20, 100, and 128 men per room; at 918 to 1,760 cubic feet and 76 to 100 square feet per man; doors on four sides.

Verandahs seldom used for sleeping.

Materials.—Stone and mud; sunburnt brick; thatched roofs; earthen floors, 3 feet above ground, no air below. Buildings only suitable for troops *en route.* Permanent barracks required. Iron barracks need verandahs.

Bedding.—Wooden cots with iron hoops.

5. Married Quarters.—None.

6. Barrack Ventilation.—Iron barracks have each four openings. Others have only doorways. "Sufficient."

7. Drainage.—Surface drainage merely. Fluid refuse of barracks carried away in filth carts and buckets.

8. Water Supply.—From wells; not liable to pollution; supply equals demand; quality excellent, but rather hard; no animalcules; no chemical analysis; water raised and distributed by ropes and buckets.

9. Intemperance.—Troops temperate. No canteen. Spirits sold in bazaar. In moderation not injurious. But malt liquor the best beverage.

10. Instruction and Recreation.—Only two skittle grounds, and no sufficient shade for exercise.

Raneegunge.

11. Hospitals.—*Site.*—Healthy.

Water supply.—Good, but has to be brought from a distance.

Drainage.—Roof water sinks into subsoil; no drains; refuse water and other impurities are carried away in carts and buckets.

Construction.—On one floor, 18 inches above ground, no ventilation beneath; brick, stone, and mud; verandahs all round. Built in 1857–60.

Accommodation.—Three wards; 114 beds at from 765 to 1,450 cubic feet and from 45 to 70 square feet per bed.

Ventilation.—Exposed to winds by doors; no means of cooling.

Cleansing.—Limewashing every six months or oftener.

Latrines.—"Naturally drained;" contents removed daily.

Lavatory.—"Sufficient;" no baths.

Hospital washing at a distance.

Storage very imperfect.

Bedding.—Wooden cots, mattress, and cotton quilt.

Cooking.—Kitchen very imperfect.

Attendance.—Hospital serjeant; natives; regimental orderlies, if required.

Sanitary state.—"Good;" hospital sufficient for temporary purposes; far from being complete; ventilation and lavatory very bad.

Convalescents.—No ward; no provision for exercise.

Female Hospital.—Separate building; "satisfactory."

Dinapore.

1. Climate.—No meteorological observations; climate a medium between damp of Bengal and drought of N.W. Damp in rains; tolerably free of dust; morning fog November and December; bronchitis and bowel disease and dysentery caused by cold nights; warm clothing required in winter, flannel in all seasons; men allowed to go out in cloudy weather; December to March most healthy months. Prevailing diseases, heat-apoplexy, fevers, dysentery, bowel and hepatic diseases. Fever follows drying up of country after rains.

2. Diseases of Native Population.—"Generally healthy, especially "the natives." Prevailing diseases: fevers, small-pox, cholera, bowel complaints, palsy of the lower limbs. *Causes.*—Too much or too little rain; bad drainage; "holes near all native houses;" some native towns "disgracefully filthy."

3. Diseases of Troops.—Fevers, remittent, quotidian, tertian; dysentery, "prevalent and severe;" cholera almost every year; rheumatism. Worst ventilated part of barrack most liable to cholera. To mitigate epidemic disease bazaars should be cleared away. Draining, filling up holes, and preventing flooding of station required. Venereal disease occasions 53 per cent. of total sick. Lock hospital would be advantageous. Increase of marriages greatly preferable. Hepatic disease causes 6½ per cent. of total admissions, and 24 per cent. of total deaths: attributable to exposure and too full diet.

4. Bazaars and Native Towns.—Bazaars overcrowded, badly drained, and filthy. Last year some streets were impassable dunghills until cleared; elephant sheds and all the south of the station in a state disgraceful to any cantonment. Meat market very bad in rains; drainage very deficient; no regular system. Drains in some places choked up; in others forming deep holes of festering mud. Ventilation very bad. No latrines, although the "population is as thick as can be;" compelled to sweep in front of their own houses; only one filth cart until lately, now three; paid for by inhabitants. Dead bodies sometimes buried within huts at Dugah. Some of the native towns are disgracefully filthy.

5. Barrack Construction.—*Site.*—Tolerably open, but ventilation obstructed by vegetation.

Two of the rooms are each no less than 826 feet long, 35 feet wide, 17 or 18 feet high, with 308 men per room, giving from 1,597 to 1,690 cubic feet per man, and 94 square feet per man; one room, for 92 men, gives 1,729 cubic feet per man, 102 square feet per man; 11 rooms, with 16 men each, give 1,020 cubic feet per man, and 60 square feet per man.

Doors on opposite sides; no windows; verandahs.

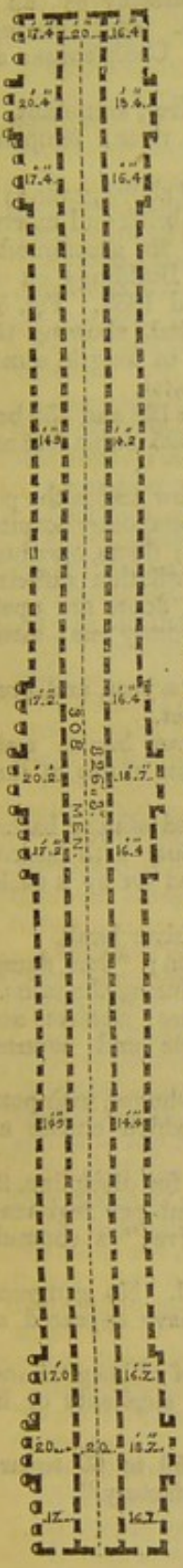


FIG. 4.—PLAN OF WEST WING INFANTRY BARRACKS AT DINAPORE.

Materials, brick and lime for permanent barracks, brick and lime plinth for temporary barracks.

Floors, 1½ to 2 feet above ground; no ventilation beneath; flooring, half-burnt brick.

Chief permanent barrack bad, runs east and west, which is the prevailing wind; hence badly ventilated.

Fig. 4 is a plan and section of part of the barracks at this station, showing a room no less than 826 feet long, having space for 308 men. It is next to impossible for barracks of this construction to be moderately healthy.

Bedsteads of wood; some few of iron.

6. MARRIED QUARTERS.—"Sufficient."

7. VENTILATION OF BARRACKS.—Doors and skylights, "which latter, however, do not open." Ventilation sufficient during day, when doors are open, but not during night, with closed doors. Cooling by tatties and punkahs, the former apt to cause chills, rheumatism, and ague.

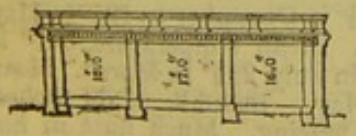
8. DRAINAGE.—By open "saucer-shaped" drains, three feet wide at permanent barracks; by an earthen drain at temporary barracks. Buildings all become more or less damp in wet season; temporary barracks most so. A foul ditch, leading to nullah in vicinity, often very offensive.

9. WATER SUPPLY.—Supply from wells and from Ganges. Some years ago barrack wells poisoned by infiltration from barrack privies. Well water clear and sparkling, but a little brackish; some of it contains sulphate, oxalate, and carbonate of lime, and some chlorides; in one well there is vegetable matter and ammonia. Water raised in leathern or iron buckets, and distributed by bheesties in leathern bags. River water after filtration the best.

10. ABLUTION AND BATH-ROOMS.—Two double washhouses and one plunge bath for each wing of barracks; water supplied by bheesties from wells; drained into a nullah; temporary barracks have no bath; lavatories drained into cesspool wells.

11. INTEMPERANCE.—Confirmed drunkards from 1 to 2½ per cent. Spirits sold in canteen, not in bazaar. Daily consumption 1 to 1⅓ drams per man, 2 drams per day allowed. Spirits "probably beneficial to old soldiers, but "not to young ones." Would be beneficial to abolish spirits as a ration and abolish the sale in canteens, substituting beer, coffee, tea, &c. There should be coffee rooms where the men could have coffee, tea, lemonade, &c., and periodicals.

12. INSTRUCTION AND RECREATION.—One fives court and four skittle grounds. A school, a library, and reading room, well lighted. A soldiers' garden, not used. Workshops insufficient. A station theatre. No gymnasia. Means not at all sufficient to keep the men occupied during wet weather and heat. A large covered space wanted for workshops, skittle grounds, ball alleys, quoits, &c. A farmyard would be advantageous, as would also be the institution of savings banks. Men confined to barracks in hot weather; said to be "beneficial." No shade but from verandahs.



CROSS SECTION.

13. HILL STATIONS.—No experience, but approve. But there is too often want of room for exercise, and difficulty in feeding the men. Hazareebaugh has a climate almost equal to the hills for health.

Dinapore.

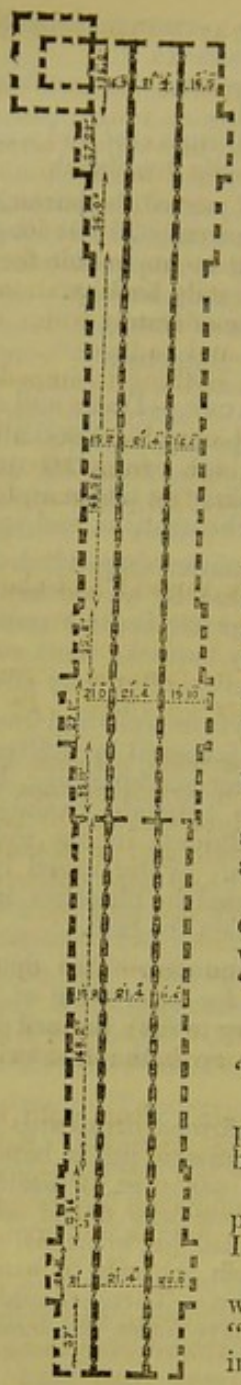
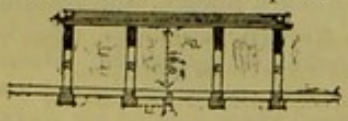


FIG. 5.—PLAN OF EUROPEAN PERMANENT HOSPITAL AT DINAPORE.

Total length of ward 633 feet; 150 beds.

Cross Section of Hospital.



14. HOSPITALS.—*Site.*—As healthy as can be obtained, but not well ventilated. That of temporary hospital somewhat better. Cook-houses and privies not judiciously placed.

Water supply from wells and river, abundant.

Drainage by pucka drains to river; temporary hospital drained into cesspools.

Construction.—Floors 1½ to 2 feet above ground; no passage for air beneath; materials, brick and mortar; verandahs 10 feet wide; used to accommodate sick when central ward is full. Buildings on one floor; erected in 1821, 1851, and 1859. Fig. 5 is a plan and section of this hospital, showing that it is only a long passage 633 feet in length, a most unsuitable construction for a hospital.

Accommodation.—Two wards for 128 and 150 beds respectively, at from 1,308 to 1,595 cubic feet and 77 to 88 square feet per bed.

Ventilation.—Wind does not blow across the permanent hospital. It does so in the temporary hospital; doors and skylights used in former; doors, openings, and roof ventilation in latter; ventilation sufficient in permanent hospital only when doors are open; sufficient at all times in the temporary one; tatties used for cooling.

Cleansing.—Limewashing twice a year, and every three months to the height of 6 feet.

Latrines over drains to the river bank; water supplied by hand; offensive in spite of use of lime and charcoal.

Lavatory and bath.—Shower and slipper baths; earthen dishes for the feet; lavatory with basins; water supplied by bheesties, turned on by a cock; "means sufficient."

Hospital washing by dhobies on river bank.

Storage ample; dry in dry season; "but damp, "as all places are at the station, during the rains."

Bedding.—Iron or wooden frames; mattress and pillows of country hemp; sheets and country blankets; bedside carpet.

Cooking.—Ordinary Indian cook-house, with pots, pans, frying-pans, and spits, "which enable an Indian cook to prepare anything."

Attendance.—Hospital serjeants for discipline, 20 ward coolies and 1 superintendent per regiment, "generally very kind and attentive;" a comrade in severe cases.

Sanitary state.—Generally good. No gangrene or pyæmia; cholera and fever have appeared at times.

Convalescents.—Walk on the roof of hospital and by river side. Often sent out on elephants or in dhoolies to take the air.

Female hospitals.—Two, with about 1,000 cubic feet and 50 to 60 square feet per bed; female attendants; "present arrangements satisfactory."

Ghazeepore.

1. CLIMATE.—Mean maximum, varies from 73½° in December to 105° in May. Mean minimum, 56° in December, 82¾° in July. Mean temperature, 64¾° in December, 93⅝° in May. Mean daily range, 14° in July, 28¼° in March. Mean sun temperature, 90° in December, 125½° in May. Rainfall, 47·32 inches. Climate not very variable. Cold season very bracing. Much dust in hot season. September, October, unhealthy from fevers of all kinds, dysentery,

Ghazeepore.

and chest affections. January to April most healthy. This applies to natives. No experience of European troops.

2. Diseases of Native Population.—Prevailing diseases, fevers, intermittent, remittent; dysentery; diarrhœa; small-pox; lung disease; spleen; attributed to "malarious nature of climate;" want of sanitary arrangements; poverty of food. October to December 1859, "fearful" fatality from "fevers."

3. Diseases of Troops.—Fevers, quotidian, tertian, quartan, remittent, ephemeral; dysentery, acute, chronic; cholera, "severely" in 1860. *Causes.*—Total want of healthy occupation; sanitary arrangements required.

4. Bazaars and Native Towns.—City a mile from station. Bazaar like all native villages. Surface drains. Streets moderately wide; kept clean. No latrines. Water supply good. Houses good and bad.

5. Barrack Construction.—*Site.*—Open; nothing to impede free ventilation.

Accommodation.—Old stables, fitted up as temporary barracks, 5 in number, each 460 feet long; 35 feet wide; 9, 11, 17 feet high; from 160 to 250 men per room; cubic feet per man, 850 to 2,108; square feet per man, 62 to 99.

Verandahs on both sides.

Materials.—Pucka, with tiled roofs.

Floors, of old stables, partly kunkur, partly brick, raised 1 foot above ground no ventilation below; neither doors nor windows.

Bedding.—Charpoy, blanket, &c.

6. Married Quarters.—Separate barracks for families. "Sufficient."

7. Ventilation of Barracks.—Ventilators on ridge. By no means sufficient. Cooling by punkahs.

8. Drainage.—Temporary drains, 1 to 3 feet wide, between barracks for surface water; not sufficient. No drainage from lavatories, cook-houses, &c. Fluid refuse mostly sinks into ground. Solid refuse removed by hand.

9. Water Supply.—Water from numerous wells and from tanks (but not for drinking purposes); quality good and sweet, "and does not seem contami-"nated by the amount of leaves that necessarily fall into open structures." Great nuisance from a large partially-drained tank. Amount sufficient; no chemical analysis. Raised by bucket and rope, and distributed by bheesties in skins.

10. Ablution and Bath Rooms.—Lavatory to each barrack; water supplied from a reservoir behind; drainage to a reservoir, emptied twice a day by a filth cart.

11. Intemperance.—On the whole temperate. Rum sold in canteen; none in bazaar. Two drams a day per man can be purchased. Sale of spirits in bazaar ought by all means to be abolished; but not injurious as sold in canteens. In moderation not injurious; but good malt liquor preferable to spirits in any form. Coffee in the morning better for the soldiers in all points. Total abolition of spirits would not be advisable. No canteen. Spirits and beer issued at once from the tub.

12. Instruction and Recreation.—One ball court, two skittle grounds. No other means of instruction or recreation. "Almost everything in this way "has yet to be done." Men confined to barracks from 8 a.m. to 5 p.m. No shade except verandahs, which are too small and under water during the rains.

13. Hill Stations.—Approves most decidedly. "There is a form of "diarrhœa and dysentery prevalent at Kussowlie and Subathoo, most diffi-"cult to treat or cure; and I believe it is the same at most other hill "stations."

14. Hospitals.—*Site.*—Open, and "perhaps as good as could be chosen."

Water supply.—"Good."

Drainage by pucka brick drains.

Construction.—Single storey buildings, of pucka and kutcha bricks; tiled roofs; floors, 2 feet from ground; no ventilation beneath; verandahs sometimes used for sick.

Accommodation.—Three wards, 156 beds, from 775 to 1,309 cubic feet, and 68 to 93 square feet per bed (100 beds have 775 cubic feet each).

Ventilation.—Free outside; windows; roof ventilators; "sufficient."

Cleansing.—Limewashing on requisition.

Latrines drained into cesspit, cleansed twice a day.

Lavatories.—Same as in barracks; large baths required.

Ghazeepore.

Hospital washing done by dhobies.

Storage sufficient.

Bedding.—Same as in barracks, infested with bugs and other vermin, to the great distress of the sick. "Scalding the bedsteads with turpentine, corrosive "sublimate, &c. is resorted to to destroy these insects, but with very partial "success." Iron bedsteads required.

Cooking "sufficient." Kitchen of ordinary construction.

Attendance "liberal."

Sanitary state "as perfect as means will allow." "Of course, all the build- "ings, generally, are most unsuitable for hospital purposes."

Convalescents.—Wards might be established. There are elephants and doolies for exercise; no shade.

Female hospital.—None; sick treated in their own quarters.

Benares.

1. CLIMATE.—Mean maximum temperature, 68°·2 in December to 98°·8 in May. Mean minimum, 58½° in December, to 87°·8 in May. Mean temperature, 65°·4 in February, 92°·2 in May. Mean daily range, 1°·6 in July, 13°·3 in January. Mean sun temperature, varies from 89°·9 in January, to 127°·5 in May. Rainfall, 37·35 inches. Climate, intermediate between Bengal and north-west provinces. Not subject to sudden change of temperature, but to considerable diurnal alternations. Atmosphere generally loaded with dust in hot winds. Climate on the whole salubrious. November to March healthiest; August to October unhealthiest; malarious fevers, dysentery, hepatitis then prevail. High temperature and moisture in rainy season. Great dry heat, with still atmosphere, accompany these diseases.

2. DISEASES OF NATIVE POPULATION.—Generally healthy. Prevailing diseases, malarious fevers; affections of spleen and bowels; "epidemics of "small-pox, caused by inoculation, common in February and March." Healthiness attributable to dry climate; not much marshy ground; sufficient food and clothing, and efficient sanitary regulations enforced by city magistrate.

3. DISEASES OF TROOPS.—Fevers, intermittent, remittent, occasion 31 per cent. of the admissions, and 13 per cent. of the deaths; dysentery occasions 6 per cent of admissions, 17 per cent. of deaths; cholera, ½ per cent. of admissions, 17 per cent. of deaths. *Causes.*—High temperature and moisture. Hepatic disease occasions 7 per cent. of admissions. *Causes.*—Alternation of temperature. Prophylactics, temperance; proper clothing; non exposure to night air. Syphilis occasions 23 per cent. of admissions. Recommendations: prostitutes to be turned out of bazaars; general native hospital at each station. Lock hospitals objectionable as leading to licensed prostitution.

4. BAZAARS AND NATIVE TOWNS.—186,000 inhabitants, between Ganges and cantonments. Bazaar tolerably clean. Many huts in rear, much crowded. "Well drained (surface)." Public latrines.

5. BARRACK CONSTRUCTION.—*Site.*—Open; external ventilation impeded by city; internal much obstructed by Suddur bazaar, which requires removal.

Accommodation.—Seven companies infantry, 1 troop horse artillery. 8 barrack rooms: 38 to 180 men per room. One house occupied by 200 men; cubic feet per man, 1,240 to 2,184; square feet per man, 77 to 136. Two barracks, 26 families each; cubic feet per family, 3,872; square feet, 242. Barrack rooms have doors on opposite sides; no windows.

Verandahs 10 feet wide.

Materials.—Chunam stone laid in mortar.

Floors, little raised above ground; no air below.

Wooden cots, with iron bands.

6. MARRIED QUARTERS.—"Sufficient" accommodation in "married men's "barracks."

7. BARRACK VENTILATION.—Roof ventilation, and an ample number of doors, sufficient. Punkahs and tatties used in hot season.

8. DRAINAGE.—"There is no sewerage at all." Drainage received into cesspools, 2½ feet diameter, 2 feet deep, close to privies and washhouses, 30 yards from nearest well, only a few yards from barracks and hospitals. Cleansed by sweepers. Contents carted away.

9. WATER SUPPLY.—Derived from numerous wells; clear, without taste or smell; soft and pure; no chemical analysis; contains slight traces of lime,

Benares.

chlorides in large proportions, slight quantity of potash and carbonic acid; amount ample. Drawn by water-carriers, with leathern buckets.

10. Ablution and Bath Rooms.—One lavatory per company, supplied with water from a well drained by branch drains. One plunge bath, another required.

11. Intemperance.—On the whole temperate. Spirits sold in canteen. Each man may purchase 2 drams a day. Average consumption last half year, ½ a dram and ½ a pint of malt liquor daily per man. Spirits certainly injurious, and the great cause of sickness and crime in a regiment. Malt liquor beneficial. Prohibit sale of spirits in canteens, and permit only beer, coffee, tea, &c. to be sold.

12. Instruction and Recreation.—One ball court and three skittle grounds. Two schools. One library and reading room, sufficiently lighted at night. One day room. One garden, two workshops, a station theatre. No gymnasium. One gymnasium and more workshops required. Present means scarcely sufficient. No sufficient shade. Men confined to barracks from 8 a.m. to 5 p.m., "with the very best effect on their health."

13. Hospitals.—*Site.*—Generally healthy.

Water supply.—Abundant and good.

Drainage.—None; roof water sinks into ground; refuse water removed in filth carts.

Construction.—On one floor. Raised 2 feet above ground; no ventilation beneath. Materials, bricks, with thatched roof. Verandahs all round.

Accommodation.—6 wards; 176 beds, at 1,161 to 1,584 cubic feet, and 72 to 75 square feet per bed.

Ventilation.—Hospitals exposed to prevailing winds. Doors numerous on opposite sides. Windows few. These with ridge ventilation sufficient. Cooling by tatties.

Cleansing.—Limewashing twice a year, or oftener.

Latrines.—Iron pans, emptied twice a day.

Lavatory.—Sufficient. A proper bath-room required.

Hospital washing.—By native washermen.

Storage.—Sufficient.

Bedding.—Wooden cots, inferior tow mattresses, coarse blankets. English blankets required.

Cooking.—Usual arrangements; "sufficient."

Attendance.—Usual provision.

Sanitary state.—Good.

Convalescents.—No wards. No shaded walks. Take airing morning and evening on elephants and in ambulances along public roads.

Female hospital.—A small one; but a larger, with a lying-in ward, is required.

Allahabad.

1. Climate.—No records; all destroyed in mutiny. Climate dry, March to June; wet, July to November; cold, October to March. Rains regular. Dust storms in dry weather. Climate requires generous and varied diet, and clothing according to season. April to June, fever, dysentery, sunstroke, cholera. During rains, dysentery and cholera. In cold, fevers, chiefly intermittent. November to March most healthy. East winds increase severity of cholera.

2. Diseases of Native Population.—On the whole healthy. Prevailing diseases, fever, intermittent, remittent; cholera; dysentery; paralysis of loins, caused by eating lathyrus sativus. "Comparative healthiness due to "full occupation; abundant food and water."

3. Diseases of Troops.—Fevers, intermittent, remittent, continued; dysentery; small-pox; rheumatism; diarrhœa; cholera. 50 per cent. of the admissions are from fever. Admissions from hepatitis 5 per cent. of strength. *Causes.*—Climate; intemperance; quality of food. Prophylactics: abolishing use of spirits, strict attention to cleanliness, clothing, duty, food, housing, recreation. 9 per cent. of sick from syphilis. Much might be done by Lock hospitals, registration, police regulation.

4. Native Bazaars and Towns.—Town, 73,000 inhabitants, 3 miles distant. No military bazaars, except for regiments; these are generally kept clean.

5. Barrack Construction.—*Site.*—One-third of the station below the level of river; open and exposed to winds. Indigo cultivated close to Wel-

Allahabad.

lington barracks; a great nuisance. Much filth and nuisance from civil bazaars; too close to lines.

Accommodation.—2,515 British, 1,871 native troops.

Five soldiers' barracks, 100 men per room; cubic feet per man, 1,437 to 1,609; square feet per man, 73 to 80; rooms, 335 feet by 22 feet by 24 feet.

One barrack, 80 men per room; 1,528 cubic feet per man; 82½ square feet per man; rooms for 40 married men; giving 4,032 cubic feet per family; and 248 square feet per family. Folding doors badly fitting; no windows.

Verandahs 15 feet wide; used on emergencies for sleeping.

Materials.—Burnt and sun-dried brick.

Roofs.—Thatch and tiles.

Floors.—Flagged; no air beneath.

Wooden cots, with cordage bottoms; harbour vermin; easily broken; iron cots infinitely better.

6. Married Quarters.—"Sufficient."

7. Barrack Ventilation.—By doors, and in some instances by small semicircular windows over, and by roof ventilation. In cells by gratings. Generally insufficient, because doors have to be closed in high winds, dust, &c. Cooling by tatties.

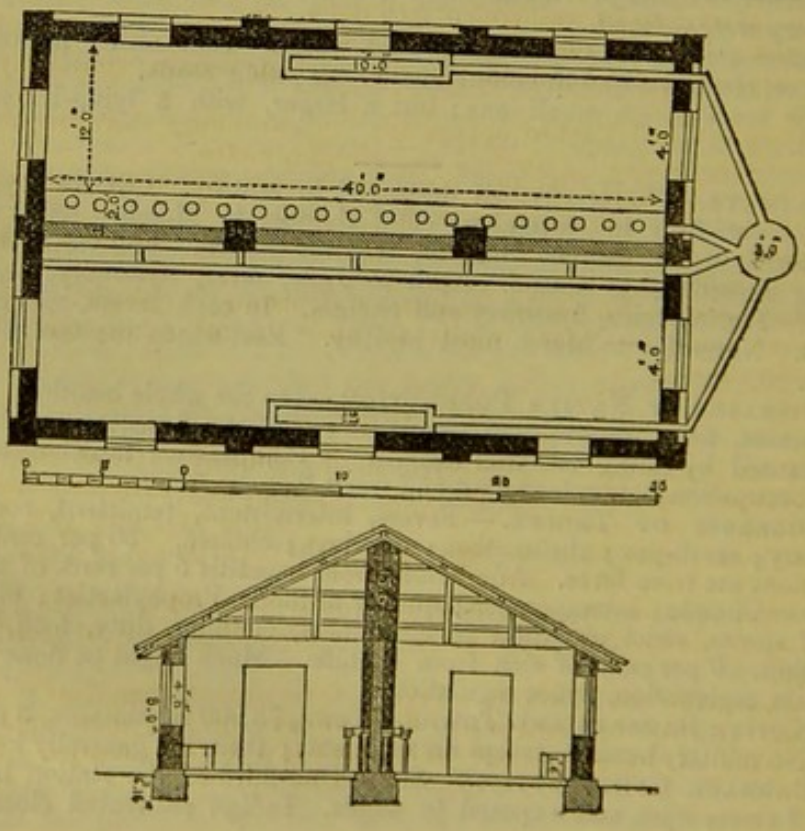
8. Drainage.—No drains or sewers; merely small channels a foot deep, 10 feet from barrack walls, for surface water. A shallow well at each wash-house into which waste water runs, and is absorbed. Floors of some buildings damp. Surface water partly evaporates, partly sinks into subsoil, partly runs off by natural drainage. Lavatory cesspools 6 feet deep, and 6 feet diameter; cleaned out daily. Contents of latrines, &c. carted away.

9. Water Supply.—Water entirely from wells; abundant; contains carbonate of lime; hard; improved by filtration; free from animalcules; sensible properties good; no chemical analysis. Raised and distributed by bullocks and water-carriers.

10. Ablution and Bath Rooms.—Lavatories have cast iron basins lined with porcelain, and a foot bath. Water supplied from wells by bheesties, and drained into cesspools.

Fig. 6 shows the general arrangement of this class of ablution accommodation.

Fig. 6.—Plan and Section of a Washhouse for Two Companies of Europeans to be attached to European Barracks at Allahabad.



Allahabad.

11. Intemperance.—Soldiers temperate; about 1 per cent. confirmed drunkards. Out of 5,021 admissions in 1859, 36 were from delirium tremens (5 fatal); 25 from ebrietas. Many diseases, especially of liver, indirectly from drink. Much sickness and mortality also indirectly. Spirits injurious to health. Entire substitution of malt liquor in canteens would be beneficial. Probable amount of spirits consumed less than a dram per man per day. But 1 quart of beer and 2 drams of rum may be purchased. Suppress sale of spirits, permit beer, coffee, tea, lemonade, &c. only to be sold.

12. Instruction and Recreation.—Skittle grounds. Schools, libraries, and reading rooms, well lighted sometimes, but generally lighting defective. No ball courts, no day rooms, no clubs, no gardens, no workshops. All commanding officers concur in recommending the latter. No theatre, no gymnasium. Present means not sufficient for hot and wet weather. Soldiers confined to barracks from 8 a.m. to 5 p.m.; said to be "beneficial to health." Men exercise in verandahs. Savings banks highly advantageous.

13. Hill Stations.—Strongly recommends occasional residence, but considers standard of health among troops in Upper Provinces, as a rule, not inferior to that among troops on hills.

14. Hospitals.—*Site.*—The best in the lines.

Water supply good and wholesome, filtered through sand and charcoal.

Drainage.—Very imperfect, inadequate during rains; roof-water mostly sinks into subsoil; only shallow narrow surface drains.

Construction.—Floors level with ground; total want of ventilation beneath; materials, baked and sun-dried brick; thatch and tile roofs, insufficient for coolness; verandahs 15 feet wide, sometimes used for sick; buildings on one floor.

Accommodation.—Four hospitals; 9 wards; 780 beds; 7 wards have 100 beds each, with from 990 to 2,033 cubic feet; and from 40 to 88 square feet per bed; built in 1858-59.

Ventilation.—Hospitals face the wind; in most instances no windows, except openings over doors, and openings in roof; ventilation very defective, especially when doors have to be closed; tatties used for cooling; no means of warming.

Cleansing.—Limewashing on requisition.

Latrines of usual construction, cleansed daily.

Lavatory.—Cast-iron basins lined with porcelain on benches; water supplied from wells by bheesties; distance from hospital too great; no baths.

Hospital washing by washermen, well done.

Storage.—Of small sun-dried bricks, tolerably dry.

Bedding.—Wooden bedsteads; fragile; harbour vermin; constantly requiring repairs.

Cooking.—Usual kitchen apparatus; proper cooking stoves required; want of suitable apparatus for roasting and grinding coffee.

Attendance "ample;" besides usual provision, 6 European nurses in general hospital, found to add much to comfort of sick.

Sanitary state "good;" but cholera has occurred; hospitals merely temporary, and deficient in many requirements.

Convalescents.—No wards; exercise on elephants; no shade.

Female hospital.—None; wards set apart in other hospitals; female attendants allowed.

Cawnpore.

1. Climate.—Records destroyed during mutiny. Great fluctuations of temperature, humidity, and pressure. Temperature extremely high during hot winds, and mortality occurs from heat-apoplexy, sunstroke, &c.; most unhealthy months, April to September, when prevailing diseases are fevers, cholera, dysentery, rheumatism.

2. Diseases of Native Population.—"Generally healthy." Cholera; small-pox; occasionally aggravated by overcrowding, want of ventilation, &c., prevail.

3. Diseases of Troops.—Fevers, intermittent, remittent; dysentery; cholera; small-pox; rheumatism of miasmatic origin; these occasion about three-fifths of the admissions and four-fifths of the deaths. Admissions

Cawnpore.

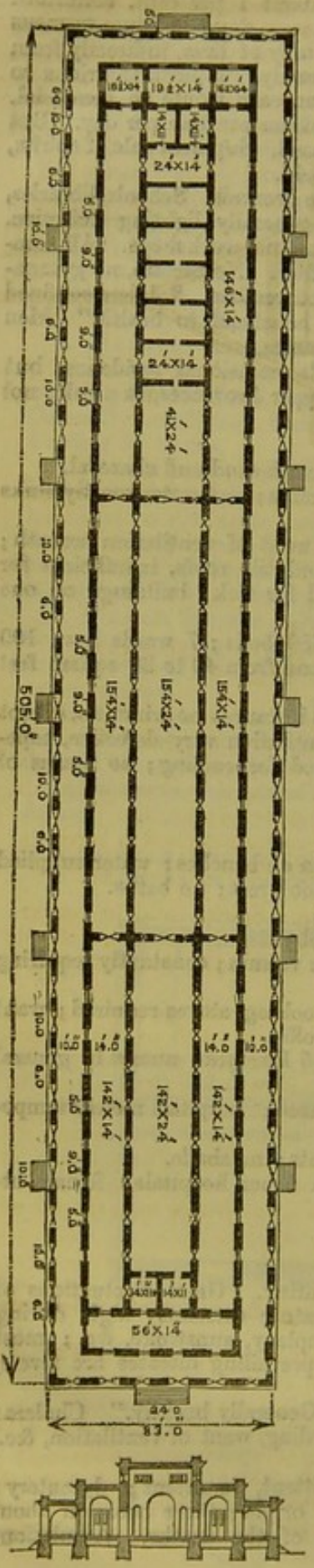


Fig. 7.—Artillery Barracks, Cawnpore.

from hepatic disease about 35 per 1,000 of admissions. Cause, intemperate eating and drinking. Venereal cases form one-third to one-half the sick. Lock hospitals would be of little if any use.

4. Bazaars and Native Towns.—Large native town, ¼ mile distant. Bazaar drains generally good. Ventilation and water supply sufficient. Many parts crowded and ruinous. People compelled to keep space in front of premises clean. No dungpits or cesspools allowed.

5. Barrack Construction. — *Site.* — Open; free external ventilation.

Echelon barracks: ten ranges for 1,000 men; 100 men per room; 1,235 cubic feet per man; 41 square feet per man; each room 168 feet long, 24½ feet wide, 30 feet high; four rows of beds between opposite windows, when the verandahs are used.

Foot artillery: 2 ranges; 120 men per room; 2,652 cubic feet per man; 88 square feet per man; each room 442 feet long, 24 feet wide, 25 feet high; four rows of beds between opposite windows, when the verandahs are used.

Dragoon barracks: 2 ranges; 140 men; 70 men per room; 1,106 cubic feet per man; 61 square feet per man.

The cubic space presupposes inner verandahs not occupied, but they have invariably been occupied; doors on opposite sides.

Materials, brick and mortar, plastered and whitewashed.

Floors of flagging laid on rammed earth and broken bricks; raised 3 feet above ground; no ventilation beneath.

Fig. 7 is a plan and section of the artillery barracks, showing the usual construction of double verandahed barracks, having terraced roofs. The plan also shows a long building divided by arches, which obstruct the ventilation. This enables us to judge of what must be the state of the air when the verandahs are occupied.

Cots, wood with twine bottoms and tow mattresses; iron cots and cocoa-nut fibre mattresses the best.

6. Married Quarters.—Married people accommodated partly out of barracks, partly in temporary hospital, partly in men's barracks, but separate.

7. Ventilation of Barracks. — By doors, windows, and over-lights near tops of walls; moveable on horizontal axes; quite sufficient. Cooling during hot winds by tatties, which effect a reduction of temperature of about 10° or more.

8. Drainage.—No sewers; only surface drains for carrying off rainfall. "Not intended" for draining cook-houses, privies, &c.

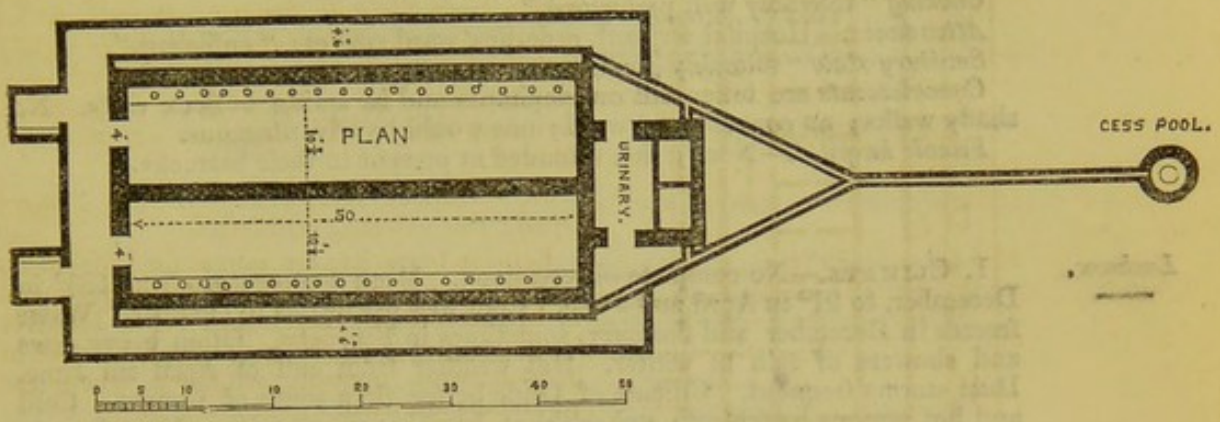
Sewage from privies received in cesspits, and removed by hand daily.

Fig. 8 shows a plan of one of the privies at this station, together with the cesspool arrangement usual in such structures. *Cawnpore.*

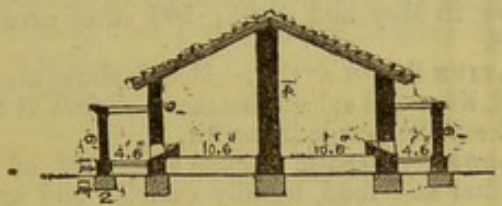
FIG. 8.

PLAN AND SECTION OF PRIVY ATTACHED TO ECHELLON BARRACKS, CAWNPORE.

One per Company.



TRANSVERSE SECTION.



9. WATER SUPPLY.—Water derived from wells; only one tank. Not liable to pollution from leaves. Quantity abundant; no peculiarity of flavour; no chemical analysis; quality "good." Raised in leathern buckets and skins. Carried by bheesties to barracks, and kept in earthen vessels for use.

10.—ABLUTION AND BATH ROOMS.—Ablution-rooms attached to barracks; no baths, but will be constructed. Water is brought from wells by pipes, and drained to nearest drain.

11. INTEMPERANCE.—Soldiers fairly temperate. Spirits sold in bazaar; not conducive to health, efficiency, or discipline. Highly beneficial if sale could be abolished. Malt liquor, tea, and coffee preferable; but men might obtain spirits otherwise.

12. INSTRUCTION AND RECREATION.—A ball court and skittle grounds. Regimental schools, libraries, and reading rooms. Workshops for tailors, shoemakers, and armourers. Cricket and quoits. Theatre occasionally. No gymnasium. Means insufficient. Properly constructed skittle grounds, gymnasia, and shooting galleries, and swimming baths required. Regimental savings banks in full operation. Men confined to barracks from 7 a.m. to 5½ p.m. in hot weather. "At least there is an order to that effect, but it is "often disobeyed." No shade whatever, except barrack verandahs.

13. HILL STATIONS.—No experience. A certain number of men should be selected from all corps and sent to the hills alternately.

14. HOSPITALS.—*Site.*—Open and freely ventilated.

Water supply "abundant and good."

Drainage.—Only by surface drains; all impurities are conveyed to a distance daily.

Construction.—Stone floors 3½ to 4 feet above ground; no ventilation beneath. Thatched roof with tiles. Double verandahs; inner ones used for sick when necessary. Building on one floor.

Accommodation.—Three wards of 24 beds each, at 2,349 cubic feet and 87 square feet per bed. When verandahs used, number of beds doubled.

Ventilation by doors and pipes carried through thatch. Hospital receives full benefit of prevailing winds. Means "sufficient."

Cleansing.—Walls and ceilings of wards cleaned and limewashed every six months or oftener.

Cawnpore.

Latrines 40 yards from hospital; consist of a shallow drain, and are offensive.

Lavatory and bath.—Small plunge bath, on the edge of which are placed vessels for washing; "neither sufficient nor convenient."

Hospital washing done at a distance.

Storage sufficient.

Bedding.—Iron and wooden bedsteads; two mattresses.

Cooking "tolerably well performed."

Attendance.—Hospital serjeant, orderlies, ward coolies; "sufficient."

Sanitary state "tolerably good."

Convalescents are taken out on elephants and in spring bullock carts. No shady walks; no convalescent ward; one would be advantageous.

Female hospital.—None; sick attended at present in their barracks.

Lucknow.

1. Climate.—No complete observations. Mean temperature from 58½° in December, to 91° in April and June. Cold weather begins in October. Water freezes in December and January, sometimes in February. Often heavy dews and showers of rain in winter. Hot weather from end of April till June. Dust storms frequent. Climate of Oude better than south of Ganges. Cold and hot seasons healthiest; unhealthiest, breaking up of rains. Most fever in June; least in January. Bowel affections in heat and rain; catarrh in cold season. Heat apoplexy in May and June; 500 cases occurred in Lucknow field force in May 1858.

2. Diseases of Native Population.—Health above average. Prevailing diseases: fevers, bowel, liver and spleen diseases; cholera at times. "Climate "and good feeding" keep the people in health.

3. Diseases of Troops.—Hepatic disease 4 per cent. of total admissions. Preventives: good shelter and food, healthy exercise and amusement, steady habits, and avoiding exposure. Syphilis, from 25 to 33 per cent. of total sick; Lock hospitals recommended. Prevailing diseases; fevers, intermittent, remittent, continued; dysentery; small-pox; rheumatism; these occasion upwards of 50 per cent. of the admissions, and 59 per cent. of the deaths. *Causes.*—Hot weather with rain, want of employment leading to debauchery.

4. Bazaars and Native Towns.—City of Lucknow, population 400,000 to 500,000, and four other cities, from a mile to two miles from cantonments; bazaars only being formed, but with due regard to plan, drainage, &c.

5. Barrack Construction.—*Cantonments*, about 40 feet above river, open and freely exposed to winds, but not so good as old station. There will be 20 barracks for infantry, 9 barracks for cavalry, when completed. Those for infantry, 72½ feet by 22 feet by 23 feet; 24 men per room; 1,528 cubic feet per man; 66½ square feet per man. Cavalry barracks, 52 feet by 22 feet by 23 feet; 18 men per room; 1,644 cubic feet per man; 72½ square feet per man.

Materials.—Burnt brick; mud cement; tiled roofs.

Floors.—Tile, 3 feet above level, no air beneath.

Bedsteads.—Wooden, much infested with bugs; iron much better.

6. Married Quarters.—Each family has 2 rooms, 18 feet by 12, and 12 feet by 12.

7. Barrack Ventilation.—Doors, windows, ventilators in roof; quite sufficient. Cooling by tatties and punkahs.

8. Drainage.—Only surface drainage. All fluid refuse received into cess-pits or tubs, and removed daily.

9. Water Supply.—From wells; mostly good; in a few, brackish; no chemical analysis.

10. Ablution and Bath Room.—Lavatories have a long masonry shelf for washing basins, also a set of small washing rooms, supplied by pipes from cisterns, receiving water from nearest well. A small canal runs the whole length of bath room to supply water to the bathers, who can draw it in earthen or leathern buckets, and throw it over themselves. Iron bars across canal to prevent bathers "lying at full length in it, and soiling the whole supply." Drained to a drain outside.

11. Intemperance.—Not much intemperance. Spirits sold in canteen. As a rule not conducive to health. Should be abolished, except in exceptional

Lucknow.

cases. Malt liquor and wine beyond doubt preferable. Beneficial to prohibit the sale in canteens, substituting beer, tea, coffee.

12. Instruction and Recreation.—The following means are being established: ball court and skittle grounds, schools, library and reading room, day room, gardens, theatre and gymnasia; but no workshops, which should be built, and then the means would be ample. Men restricted to barracks in hot months.

13. Hill Stations.—Approves of hill stations; but troops very liable to diarrhœa on arriving. Considers location on hills with short service on plains the best.

14. Hospitals.—*Site.*—Good; best available.

Water supply.—Sufficient.

Drainage.—None; only on surface.

Construction.—Burnt bricks and lime; tiled roofs; verandahs: floors raised 3 feet; no passage of air beneath; built 1859.

Accommodation.—Ten wards, with a number of small rooms, 2,737 cubic feet, and 75 square feet per bed.

Ventilation.—Windows on pivots near top of wall; doors; ventilating tiles in ridge; cooling by tatties.

Cleansing.—Limewashing once a year, oftener if necessary.

Latrines.—Too close to main buildings; water supply not sufficient; contents removed by sweepers.

Lavatory.—A small room to each ward; patients wash in tubs or earthen vessels without arrangement; one or two masonry baths; barely sufficient.

Hospital washing by dhobies.

Storage.—Quite sufficient.

Bedding.—Wooden cots, mattress, &c.; iron cots better.

Cooking.—Good and sufficiently varied.

Convalescents.—No special wards; exercise in verandahs or on elephants.

Female hospitals.—Provided; "quite satisfactory."

Sanitary State.—"Good." Larger and better bathing houses would be an improvement.

Jhansi.

1. Climate.—Records destroyed during mutiny. Climate healthy and bracing, except in hot weather. Cold season healthiest. Intermittent fever in August and September.

2. Diseases of Native Population.—Generally healthy. Fevers and venereal; small-pox, occasional; cholera, almost unknown.

3. Diseases of Troops.—One case in 15 from hepatic disease. Syphilis not prevalent. Prevailing disease: fever, intermittent; a few cases of dysentery.

4. Bazaars and Native Towns.—City a mile off; bazaar new and incomplete, but well drained; public latrines, but police insufficient at present.

5. Barrack Construction.—*Site.*—Open in every direction; no obstruction to ventilation.

Infantry barracks.—Two rooms; 24 men each; each room 67 feet by 22 feet by 28 feet; giving 1,715 cubic feet and 61 square feet per man.

Two iron framed rooms, 24 men each, with 1,014 to 1,170 cubic feet and 63 to 65 square feet per man.

Verandahs, 12 feet wide, usually occupied for sleeping in hot season, and temporarily, when the barracks are overcrowded.

Floors.—Lime plaster: 3 feet above ground; no passage of air beneath.

6. Married Quarters.—None. Pendalls occupied temporarily.

7. Barrack Ventilation.—Ventilating windows on both sides, above doors; generally sufficient. Cooling by punkahs and tatties.

8. Drainage.—Surface drainage. Other drainage received into cesspits, 3 feet cube, and removed morning and evening.

9. Water Supply.—From wells; preserved from pollution; supply sufficient; hard; agreeable to taste; no chemical analysis.

10. Ablution and Bath Rooms.—Lavatories not finished; to be on the standard plan.

11. Intemperance.—Temperate. Spirit sold at canteen. Not injurious in moderation. Not conducive to health. Malt liquor and wine beneficial, being tonics. Spirits only temporary stimulants. Beer might be substituted

Jhansi.

by degrees for spirits, but would not be beneficial to prohibit sale to men accustomed to spirits.

12. INSTRUCTION AND RECREATION.—Schools, library, and reading room, day room, one garden, and workshops. No ball courts, no skittle ground, no theatre, no gymnasia. Present means not sufficient; all the above should be supplied, together with swimming baths. Shade not sufficient. In hot weather, men restricted to barracks from 8 a.m. to 5 p.m. Savings banks advantageous.

13. HOSPITALS.—Hospitals not yet built. A barrack used temporarily. No female hospital.

Morar Gwalior.

1. CLIMATE.—Mean maximum temperature, from 70½° in December to 106° in July. Mean minimum, from 56½° in December to 86° in May. Mean temperature, 61½° in December, 96° in June. Mean daily range, from 3½° in September to 18½° in February. Rainfall about 25 inches. Climate salubrious, dry and hot. Too many trees. Air often loaded with dust. Healthiest at end of cold weather. Unhealthiest at end of hot and wet weather. In May and June head and bowel affections and fever prevail. After rains fever and bowel complaints.

2. DISEASES OF NATIVE POPULATION.—Very healthy. No epidemics since 1858; attributable to dry climate and soil; abundant and cheap food.

3. DISEASES OF TROOPS.—Hepatic disease not unusually frequent. *Causes.*—Hot dry climate, too much animal diet, too few vegetables, ardent spirits. Prophylactics: malt liquor, potatoes, instead of native vegetables. Syphilis has been as high as 80 per cent. of the sick; seldom under 12 or 20; Lock hospitals and police regulation recommended. Prevailing diseases: fever, chiefly intermittent, dysentery, rheumatism; these occasion 44 per cent. of admissions. No cholera or small-pox.

4. BAZAARS AND NATIVE TOWNS.—Town 2½ miles distant; bazaar well drained and ventilated; water from wells; latrines constructed; five sweepers attend to cleanliness.

5. BARRACK CONSTRUCTION.—*Site.*—Open, but trees should be cleared away.

Accommodation.—For two batteries of artillery, British troops; 12 companies of infantry, British troops; 1 regiment, cavalry, native troops; 2 regiments, infantry, native troops; 48 to 160 men per room; 67 to 93 square feet per man; 1,280 to 1,740 cubic feet per man.

Materials.—Stone or kutcha or burnt brick and mud; roofs, thatched or tiled.

Floors of concrete, brick, or stone; in new barracks will be raised 4 feet above ground; no passage of air beneath.

Bedsteads.—Wooden.

6. MARRIED QUARTERS.—Married quarters only temporary.

7. BARRACK VENTILATION.—Small ventilators in ridge of old barracks. Imperfect. Ventilation in new barracks will be ample, by windows, and by tubes in ridge.

8. DRAINAGE.—Surface drainage by open drains. All other drainage from washhouses, privies, urinals, and cookhouses conveyed into cesspools and removed by carts. Cesspools "never less" than 50 yards from nearest well.

9. WATER SUPPLY.—From wells for drinking and cooking; soft, abundant, excellent; no chemical analysis. Drawn by bheesties in leather buckets, and carried in leather bags, stored in baked earthen vessels.

10. ABLUTION AND BATH ROOMS.—Lavatory for each company. Tubs or earthen vessels for holding water, supplied by bheesties from nearest well. Wash-hand basins, earthen or metal. Drainage into a cesspool 4 or 5 feet deep. Filth or refuse matter carried away from cesspool every morning.

11. INTEMPERANCE.—Several intemperate men. Liquor difficult to get at present. Less than 1 per cent. of admissions directly, more than 2½ per cent. indirectly, from drink. Spirit causes a good deal of sickness. Fatal cases occur mostly among intemperate men. Drunkenness much the prevailing crime at station. Spirits sold in canteen to the extent of one dram with beer, two without, per diem. Ardent spirits, except as medicine, always injurious. Malt liquor much less so. Most beneficial to suppress sale of spirits, if men

Morar Gwalior.

did not use native liquor. Recommended prohibition of distillation, except for medical or chemical purposes.

12. Instruction and Recreation.—Company skittle grounds, regimental schools, library and reading room. No doubt ball courts, clubs, gardens, workshops, theatre, and gymnasia will be introduced in due course. Shade insufficient.

13. Hill Stations.—No experience; but has no great confidence in hill stations. Considers that invalids should be sent to the sea-side.

14. Hospitals.—Present hospital an old barrack, on an open airy site, but has a sluggish malarious nullah in front.

Water supply.—Any amount available.

Drainage into cesspits constantly emptied.

Construction, on one floor, raised 5 to 6 feet above ground.

Accommodation.—Five wards, 100 beds, 1,540 cubic feet, and 103 square feet per bed.

Ventilation.—No windows, only doors.

Lavatory, temporary. Sick bathed in tubs. Neither sufficient nor convenient.

Storage indifferent. None properly so called. Sometimes tents used, sometimes part of the hospital when there is room.

Cooking.—Kitchen "not commodious."

Sanitary state in every respect objectionable. New hospital much required.

"No women and no hospital."

Agra.

1. Climate.—Mean maximum temperature varies from 73°·3 in January to 112°·7 in June; mean minimum temperature varies from 42½° in January to 83°·3 in June; mean daily range 18°·4 in July to 38°·1 in April; mean daily temperature 66°·9 in January to 97°·1 in June. Rainfall about 10½ inches. Climate from end of October to beginning of April cool, clear, and healthy; very hot and dry, but not unhealthy till end of June; hot and moist till end of September, when fevers prevail; much dust in hot season; much animal food not required; exposure to sun to be avoided in hottest season; flannel belt required. Healthiest months, November to April; unhealthiest, August to October. Miasmatic fever, with dysentery, prevails; sunstroke frequent in May and June; liver complaints prevail in hot and rainy season; chest affections in cold season.

2. Diseases of European Troops.—Fevers, continued and miasmatic; small-pox; cholera; rheumatism; sun-stroke. *Causes.*—Climate; drinking spirits; sleeping close to ground. Liver disease. *Causes.*—Heat; exposure; alcoholic liquors; excess of diet. 8·77 per cent. of admissions are venereal cases. Lock hospitals, with inspection recommended.

3. Bazaars and Native Towns.—City, 152,000 inhabitants, a mile distant. Bazaar open, clean, ventilated, not crowded. Water from wells abundant, but rather saline. Native houses clean, but villages low, with narrow and irregular streets; dunghills at the outskirts; the "more "respectable" houses have cesspools. Inhabitants generally resort to the fields.

4. Barrack Construction.—*Site.*—Open; few trees; temperature hot, from baked dry soil and ravines.

76 serjeants' quarters; 23 barrack rooms for 1,776 non-commissioned officers and men; rooms from 204 to 288 feet long, 12 to 24 feet wide, 20 to 28 feet high; 1,379 to 1,912 cubic feet per man; 60 to 79 square feet per man.

Doors on each side, with glazed fanlights; no windows.

Verandah, 12 feet wide, occasionally occupied as sleeping quarters.

Materials, burnt brick and mortar; roofs thatched.

Floors, stone over brick, 3 feet above ground; no ventilation beneath; not sufficiently raised above malaria; should be two-storied.

Bedsteads, wood; should be iron to keep out bugs.

5. Married Quarters.—Families occupy a large separate barrack, with plenty of room.

6. Barrack Ventilation.—Iron ridge ventilators, with openings in inner walls. Sufficient, provided verandahs not occupied as sleeping rooms. Cooling by tatties, which reduce the temperature of hot west wind from 120° to 80° Fahrenheit. Punkahs used.

Agra.

7. Drainage.—Surface drains, 3 feet deep by 8 feet wide. Surface water lodges in vicinity of barracks until it sinks into the sandy soil, rendering raised paths necessary between the barracks. Water from lavatories collected in an open cesspool, from which it is spread over the ground. Fluid refuse partly sinks into subsoil, part is carted away, and part evaporates. Refuse water removed in barrels every morning. Hospital cesspits are deep wells, never cleaned. "Tried to be kept sweet by lime, but in vain."

8. Water Supply.—Principally from wells; occasionally from river. Well water very salt, with few exceptions. Considered heating during rainy season. Contains large quantities of muriate and sulphate of soda and lime. It is laxative, and apt to disagree at first. Supply sufficient. Raised in leathern bags by bullocks, and carried in skins by bheesties for the use of Christian and Mussulman. Hindoos carry their water in brass or earthen jars.

9. Lavatory and Bath Rooms.—Lavatories of solid masonry, with tiled roofs; water supplied from copper cistern filled from a tank attached to well; waste water collected in cesspits and "carted away;" four baths supplied from wells; waste water carried away by surface drainage.

10. Intemperance.—Soldiers usually temperate; spirits sold in canteen, forbidden in bazaar. During cold season, 2 drams of rum, 1 quart of beer, issued to each man per diem. During hot season, 1 dram of rum, 1 quart of beer. This is the average daily consumption per man throughout the year. Evil effect of spirit drinking manifest during last field service; spirits in excess the bane of European soldier; would be better to allow beer or porter; "but "they will have spirits," and to abolish the sale would drive men to the bazaar.

11. Instruction and Recreation.—Double ball court, and three skittle alleys; schools, library, and reading room, indifferently lighted at night; soldiers' garden, worked by natives, supplies vegetables for mess; no soldiers' clubs, no day rooms, no workshops, no theatre in barracks, no gymnasium. Means insufficient for affording occupation in hot or wet weather. Men confined to barracks between morning and evening parades; restriction said to be "necessary, but very irksome." A large covered building for gymnasium, workshops, games, &c., "would draw many men from their cots, where they 'idle and sleep all day.'" No sufficient shade. Savings banks useful for provident men.

12. Hill Stations.—Decidedly approves of hill stations. Hot season there most agreeable, but cold season most invigorating. Men residing on hills keep their stamina best and stand work better on the plains than other troops. Barracks at Landour imperfect. Elevations of 4,000 feet are beyond the influence of tropical climates, and less cloudy, but not so cold and bracing as higher elevations. Plenty of level ground, good water, and easy access are desiderata.

13. Hospitals.—*Site.*—Open, healthy, and freely ventilated.

Water supply.—Ample from wells, though generally very salt; several better wells used for drinking.

Drainage.—None except on surface; during hot and cold season the washing and bathing water spreads over ground and sinks into soil or evaporates. Main drain only runs after heavy rains.

Construction.—Hospital on single floor, raised 2½ feet, but no passage of air below; materials, brick and mortar; thatched roof; double verandahs, inner one frequently used by sick and convalescents.

Accommodation.—Three wards; 120 beds, at from 1,320 to 2,135 cubic feet, and from 55 to 73 square feet per bed.

Ventilation by ridge ventilators, open doors, tatties, and thermantidotes; also punkahs; "sufficient."

Cleansing.—Whitewashing quarterly or oftener.

Latrines over cesspits, into which close stools are emptied; very offensive.

Ablution and bath room.—Bathing tubs; "sufficient for the purpose and "convenient;" a washhouse being constructed.

Hospital washing done at a distance.

Storage sufficient.

Bedding.—Bedsteads of wood, hemp mattresses and pillows; cotton sheets, woollen blankets, or wadded cotton "resais."

Cooking.—Kitchen same as in barracks; "sufficient."

Agra.

Attendance.—Hospital serjeant for discipline; regular establishment for European corps at ordinary times consists of 79 individuals, to whom are added in hot seasons 161 bheesties and coolies, making in all 240.

Sanitary state.—Hospitals "as free from disease as ground floor hospitals of "this construction can be." All tropical hospitals should be two storied (the sick above).

Convalescents.—No wards; men sent to light duty in barracks; exercise by elephants and doolies; seats in verandahs and arm chairs.

Female hospital.—One adjoining general hospital; "satisfactory."

Muttra.

1. Climate.—No instruments or records. Climate produces heat apoplexy, hepatitis, continued fever. "Just now air over entire district a mass of dust, "sometimes obscuring the sun." Diet of troops ought to be lighter; less meat, light puddings, plenty of fruit and vegetables. Healthiest months, October to March; sickliest, April and May, from continued fever and hepatitis.

2. Diseases of Troops.—Hepatic diseases 2·84 per cent. of admissions; much more in hot weather. Preventives: avoiding exposure and chills, wearing flannel belts. Venereal disease is 14·1 per cent. of total sick; to diminish it, no cantonment to be nearer than four miles to a city. Lock hospitals would then be advantageous. One in 3·7 admissions occasioned by fever, continued, intermittent, by dysentery, small-pox, and rheumatism.

3. Bazaars and Native Towns.—City three-quarters of a mile off. Bazaar an accumulation of huts, without order. "Drainage bad; ventilation "worse; water supply execrable." "All the wells brackish, from nitre," the earth being contaminated with all sorts of impurities. Latrines "hardly "known." "In short, the bazaar is a mass of filth."

4. Barrack Construction.—*Site.*—Encumbered with trees, interfering with ventilation; broken ground, filthy nullahs, stagnant waters, and other nuisances. The large filthy city of Muttra is on the north-west, whence blows the wind.

Seven barracks, for 400 European troops, with 40 to 104 men per room 1,000 to 1,575 cubic feet per man; 60 to 75 square feet per man.

Materials.—Chiefly unburnt bricks and cement.

Floors raised 2 feet above ground; stone slabs over brick; no air below.

Ordinary Cots used.

5. Married Quarters.—"Sufficient" for married non-commissioned officers. Married men of cavalry occupy old cavalry barracks. In artillery, married people occupy barrack rooms with the men.

6. Barrack Ventilation.—Ridge ventilation the entire length; not sufficient at night. Cooling by tatties.

7. Drainage.—Temporary drains 1½ to 4½ feet deep for surface water. All other drainage from lavatories, baths, wash and cookhouses, privies, and urinals carted away in vessels.

8. Water Supply.—Water from wells and from river. Some wells contain large quantities of sulphuretted hydrogen on account of their low situation and the imperfect surface drainage. This water drunk by natives. In the station some wells good; others close to them impregnated with salts. Abundance of good water. Raised and distributed by ropes and leather buckets. No chemical analysis.

9. Ablution and Bath Rooms.—Three temporary shed lavatories. One plunge bath.

10. Intemperance.—Artillery very intemperate; 10 per cent. confirmed drunkards. Cavalry temperate; 1 admission in 91½ caused directly by intemperance; two drams of rum per man per day allowed in canteen. Any amount of bazaar spirits attainable. As a general rule, spirits not conducive to health or discipline; but could not be withheld from men accustomed to them. Suppress sale to all men under 30 years of age. Malt liquor better. Suppress spirits gradually, and permit only beer, coffee, tea, lemonade to be sold.

11. Instruction and Recreation.—No means of instruction, occupation, or amusement whatever, except a soldiers' garden, for which there are no tools, although indented for a year ago. Carpentry, saddlery, and coopers' work are

Muttra.

in great demand, and would benefit the men, as regards health, morals, and finance. No sufficient shade.

12. Hill Stations.—No experience; but approves of hill stations.

13. Hospitals.—*Site.*—Cavalry hospital good. Artillery hospital too near the city, with a dry nullah close to it.

Water supply.—Good.

Drainage.—No drains; refuse water and other impurities collected in cess-pools and removed daily.

Construction.—Burnt and unburnt bricks. Tiled and thatched roofs. Verandahs; inner ones very frequently used for sick. Single-storied. Floors 2½ feet from ground; no passage for air beneath.

Accommodation.—Three wards, 48 beds; square feet per bed, 64 to 75; cubic feet per bed, 1,350 to 1,422; the new female hospital used for cavalry.

Ventilation (external) of cavalry hospital good; of artillery hospital not so. No windows; doors opposite each other, with roof ventilators. Thermantidotes for cooling.

Cleansing.—Walls swept down weekly; whitewashed annually, or oftener.

Latrines.—Copper pans. Contents carted away every morning for combustion in one of the many brick-kilns that surround the station and help to poison the air. Privy drainage runs into cesspool. No supply of water except by bheesties.

Lavatory.—Earthen pans or basins, and earthen vessels filled with water; not convenient. No means of bathing but a moveable warm and slipper bath.

Hospital washing done at the river.

Storage.—Sufficient.

Bedding.—Common cots, with tow mattresses and pillows, &c.

Cooking arrangements "sufficient."

Attendance.—Insufficient; more European supervision required. "In times "of increased sickness apathy and laziness of natives always embarrasing, and "a source of complaint and discontent to the patient."

Sanitary state.—Fair; but, as a general rule, hospitals are badly lighted and gloomy. Light enters from a couple of panes in the doors near the top; and, when closed, darkness almost complete. Windows wanted.

Convalescents.—No wards. Sick exercised on elephants, or in doolies.

Female Hospital.—One for cavalry (part of the old cavalry hospital); none for artillery.

Delhi.

1. Climate.—No records. Mean temperature varies from 92° in June to 56° in January. Rains continue with intermissions from end of June to end of September. Rainfall, 10 inches and upwards. Hot winds, dust storms, April to June. Climate unusually dry; favourable to Europeans. Unhealthy months, September, October; from low fever.

2. Diseases of Native Population.—Generally healthy. Fevers; spleen; ulcers; small-pox, less frequent from dry weather of late, more frequent after heavy rains; ulcers, prevalent, supposed to be caused by water.

3. Diseases of Troops.—Hepatic disease. *Causes.*—Climate, excessive eating and drinking, exposure, want of exercise of body and mind. Syphilis one-third of total sick; inspection and Lock hospital recommended. Prevailing diseases; fever, intermittent, remittent, continued; dysentery, acute, chronic, hæmorrhagic; cholera; rheumatism. *Cause.*—"Exposure to night duty."

4. Bazaars and Native Towns.—Station inside city walls; bazaar being established.

5. Barrack Construction.—*Site.*—Inside walls of city; not well ventilated; temperature raised by reflected sun heat. Present barracks temporary; for 959 European troops; 1,408 native troops.

6. Married Quarters.—Married people reside in separate quarters.

7. Barrack Ventilation.—Cooling by punkahs. In temporary quarters.

8. Drainage.—All refuse carried down to the river.

9. Water Supply.—Mostly from river, some from wells; latter, with few exceptions, brackish; not good; contains soda; no chemical analysis. Drawn and distributed in usual manner.

Delhi.

10. Intemperance.—"Inclined to be intemperate." Four men per company confirmed drunkards. Spirits sold in canteen. About three-fourths take one dram, one-fourth two drams each per day; injurious. Moderate use of malt liquor or wine good. Not beneficial to suppress the sale of spirits, because country liquor would be bought instead.

11. Instruction and Recreation.—Skittle grounds, schools, a library and reading room; sufficient. Soldiers confined to barracks in hot weather. Shade not sufficient.

12. Hill Stations.—Approves. Troops should be located on hills with short service on plains. Accommodation not sufficient for convalescents at any hill station.

13. Hospitals.—No regular hospital. A temporary hospital of bricks, stone, and mortar, on one floor. Too much surrounded by walls and other buildings for free ventilation. No windows, only doors. Ventilation of wards by doors and openings. Latrines of usual construction. Lavatories with iron and wooden baths. Cooking pretty well done. Whole arrangements temporary.

Meerut.

1. Climate.—Mean maximum temperature, 69° in December, 103° in May; mean minimum 49¾° in January, 84½° in July; mean daily range, 9° in September, 31° in November; mean sun temperature, 84° in December, 118° in May. Rainfall 17·89 inches. Climate good; dry a great part of year; not variable; fogs very rare; much dust in dry seasons; no bad influence on health; most healthy months, December till March; most unhealthy months, August to October, when fevers, intermittent, remittent, and continued; catarrh, diarrhœa, dysentery, and hepatitis prevail. Fevers most prevalent at end of rainy season; small-pox in March and April. Great variation of temperature produces influenza, sometimes cholera.

2. Diseases of Native Population.—"Considered healthy." Diseases: fever, diarrhœa, dysentery, small-pox, spleen, cholera, not so frequent as elsewhere. Comparative healthiness attributable to porous soil, cultivation, and few sources of malaria, free ventilation.

3. Diseases of Troops.—Fevers, intermittent, remittent, continued, occasion 56 per cent. of total admissions, and 25 per cent. of total deaths; dysentery; cholera; small-pox; rheumatism. Hepatic disease occasions 18 per 1,000 of total admissions. *Causes.*—Intemperance; exposure; long residence; malarial fever. Eight per cent. of total admissions are venereal cases. Lock hospitals "decidedly advantageous, if combined with police supervision."

4. Bazaars and Native Towns.—Town a mile distant from lines. Bazaar drained, well ventilated, and supplied with water from wells. Cleanliness strictly enforced. Public latrines. Native houses generally filthy. Dung-heaps frequent. Pits for all kinds of refuse common.

5. Barrack Construction.—*Site.*—Open; free external ventilation varies with locality.

705 rooms, for 4,227 non-commissioned officers and men; length of men's rooms, 44, 198, 210, and 215 feet; width of men's rooms, 22, 24, 30 feet; height of men's rooms, 16½ to 26½ feet; cubic space per man, 868 to 1,968 feet; square feet per man, 52 to 79.

Windows and doors on opposite sides.

Verandahs on both sides, occasionally used as sleeping quarters.

Materials, brick and lime mortar; thatched or tiled roofs.

Floors, brick or stone, with concrete over; generally raised 2 feet above ground; no ventilation beneath.

Wooden cots; cotton mattress; iron bottoms would be better.

6. Married Quarters.—"Sufficient."

7. Ventilation of Barracks.—By doors, windows, and openings in roof, generally sufficient. Cooling by tatties and punkahs.

8. Drainage.—By open masonry drains to a large tank and nullah, 1,700 feet and 5,000 feet distant; sufficient for surface water. Fluid refuse drained into cesspools close to washhouses, &c., 4½ feet in diameter, and 40 feet deep; 60 feet from nearest barracks; 670 feet from wells. They seldom require cleansing. It is done by opening the tops, and drawing out the fluid in buckets. Some foul ditches about a mile from barracks.

Meerut.

9. Water Supply.—Water from wells. Tanks used by natives; nuisance and malaria from some of them. Supply soft, excellent, unlimited. Raised by leathern buckets and bags, by hand or by cattle.

10. Lavatory and Bath Rooms.—One lavatory per company; two plunge baths per regiment.

11. Intemperance.—Soldiers temperate; rum sold at canteen. Native spirits occasionally smuggled into barracks. Soldier allowed 2 drams per day, or 1 pint of beer, 1 dram, on payment. Spirits injurious to health; malt liquors and wines less injurious; tea, coffee, &c. better than either; beneficial to prohibit sale of spirits, and permit only beer, tea, coffee, &c.

12. Instruction and Recreation.—Ball courts and covered skittle grounds. Schools and a theatre. No library, no day room, no soldiers' club. No gardens, no workshops, no gymnasia. Present means not sufficient to keep men occupied during wet or heat. Savings banks very advantageous. Men should have indoor employments at trades. Shade quite insufficient. Men confined to barracks from 8 a.m. to 4½ p.m. in hot weather. Less restriction in cold season, "and with the best possible results."

13. Hospitals.—*Site.*—Open, freely ventilated, and healthy.

Water supply.—"Abundant and wholesome."

Drainage.—By open masonry drains into tank and nullah.

Construction.—Floors 1 to 2 feet above ground; no passage for air beneath; materials, brick and mortar; roof, tiles over thatch; verandahs all round, some double; inner one sometimes used for sick. Built in 1810, 1811, 1830, 1845, 1846, 1856.

Accommodation.—Four wards, containing 428 beds, at from 1,052 to 1,622 cubic feet, and from 67 to 78 square feet per bed. One of the wards contains as many as 160, another 100, and another 104 beds.

Ventilation.—Hospital receives full benefit of prevailing winds. Doors, windows, and circular holes in side walls, and also in roof. Khuskhus tatties and thermantidotes used for cooling the air.

Cleansing.—Limewashing annually, or oftener if required.

Latrines adjoin hospital; supplied with water; contents removed in filth carts; urinal has a cesspool.

Lavatory and bath.—One bath in lavatory; said to be "sufficient."

Hospital washing done by native washermen.

Storage sufficient.

Bedding.—Wooden bedsteads, hemp mattresses, sheets, and blankets; iron bedsteads recommended.

Cooking.—Common Indian kitchen; diets properly cooked.

Attendance.—Hospital serjeant and natives; no nurses; orderlies for special cases.

Sanitary state "excellent." No hospital disease.

Convalescents.—No wards, but such would be advantageous; elephants and doolies used for airing.

Female hospitals.—Separate arrangements; "satisfactory."

Nynee Tal.

1. Climate.—No proper instruments. Average temperature, from 48¼° in January to 68° in June. Rainfall varies in different years from 68 to 144 inches. Climate excellent; damp in rains, but dry and pure at other times. Too many trees. Residents have good health. Sun powerful in summer. Winter months most healthy, and best adapted for invalids. No endemic diarrhœa.

2. Diseases of Native Population.—Generally healthy. Prevailing diseases, fevers, intermittent, with spleen and small-pox. *Causes.*—Sudden variations of temperature; dense underwood; living in hollows; want of free ventilation.

3. Diseases of Troops.—Hill station. Fever, quotidian; dysentery (from plains); rheumatism, acute; hepatic disease (from plains).

4. Bazaars and Native Towns.—Both bazaars in a filthy and crowded state; no proper drainage, nor latrines; stench at times overpowering; no means of preserving cleanliness; native houses small and badly ventilated; want of public latrines causes nuisance in barracks.

Nynee Tal.

5. Barrack Construction.—*Site.*—Perfectly open; 6,409 feet above sea. *Accommodation.*—740 British troops; 230 native troops; 21 barracks, 2 rooms in each; 20 men per room; with 630 cubic feet and 45 square feet per man; construction, temporary, stone, roofed with thatch; not sufficient for troops. Permanent barracks proposed.

Floors.—Pucka; 1 to 2 feet above ground; no air beneath.

Verandahs 6 feet wide; not used for sleeping.

Bedding, simple rope charpoys, with blankets and sheets.

6. Married Quarters.—None. Married men use the same barrack rooms as the rest, divided only by a partition.

7. Barrack Ventilation.—Two ventilators in roof of each hut. Chimneys of bad construction. Constant smoke in huts. Otherwise air "pure."

8. Drainage.—Natural drainage removes surface water, barracks being built on a hill side. Fluid refuse flows down a steep declivity to plains below. No cesspits required.

9. Water Supply.—Partly from springs, partly from lake; the latter used for drinking, bathing, and washing; supply unlimited, pure, soft, wholesome; no chemical analysis. Raised by bheesties, in skins. Part conveyed to barrack in wooden watercourse.

10. Ablution and Bath Rooms.—Hill station. No lavatories. Men wash themselves in verandahs.

11. Intemperance.—Temperate. One case delirium tremens last year. Men all invalids, require daily stimulant, 1 quart of beer and 1 dram of rum allowed daily. Amount specified conducive to health. Suppression of spirits generally would be beneficial, with exceptional cases.

12. Instruction and Recreation.—Two skittle grounds, one school, one library, well lighted; men confined to barracks in heat of day. Present means not sufficient to keep men occupied. No shade, except verandahs.

13. Hill Stations.—Approves most decidedly. Head quarters should be on the hills, with detachments doing duty on the plains.

14. Hospitals.—*Site.*—Healthy; freely ventilated.

Water supply.—Good.

Drainage.—None required.

Construction.—Two floors; lowest 6 inches above ground, highest, 10 feet; materials, rubble, stone and lime; open verandahs all round.

Accommodation.—Eleven wards; 45 beds. Patients fluctuate from 50 to 3.

Ventilation.—Scarcely possible to ventilate properly, too many windows; situation exposed; draught too strong; warming by open fires in winter.

Cleansing.—Limewashing all over once a year; every three months 6 feet high.

Latrines kept clean by sweepers.

Lavatory.—Chatties and tubs for washing; no baths; sick bathe in lake.

Hospital washing by washermen.

Storage sufficient.

Bedding.—Wooden cots.

Attendance.—One hospital serjeant; one European barber; one European orderly.

Sanitary state.—Healthy; "during rains, however, open surfaces of blisters, "&c., do not heal kindly."

Convalescents.—All are so; exercise in chairs carried by coolies; shaded walks.

Female hospital.—One separate room. All the present arrangements temporary and unsatisfactory.

Roorkee.

1. Climate.—Climate very healthy, quite equal to that of England. September and October unhealthiest, from fever intermittent and mild continued.

2. Diseases of Native Population.—Population healthy. Small-pox very common and destructive in spring, when inoculation is practised; cholera, occasional; spleen, rare. Healthiness attributable to dry sandy soil and mild climate.

3. Diseases of Troops.—Hepatic disease 1 per cent. of cases. *Causes.*—Spirit drinking, malaria. Syphilis more than 50 per cent. of sick; inspection recommended. Troops suffer slightly from fever, intermittent and continued (not from dysentery), cholera, small-pox occasional, rheumatism common.

Roorkee.

These diseases occasion about one-third of the admissions and about three-fourths of the deaths.

4. Bazaars and Native Towns.—Bazaar 1½ miles from barracks; no information as to its state.

5. Barrack Construction.—*Site.*—Open; some private houses enclosed with trees.

Accommodation.—For 487 British troops in 21 barracks, each 100 feet by 10 feet by 20 feet; at 30 men per room; with 666 cubic feet and 33 square feet per man.

Materials.—Mud bricks; thatch and tile.

Floors.—Brick, 4 feet high; no passage of air beneath.

Verandahs, 10 feet wide; not used as sleeping quarters.

Bedsteads.—Wood; harbour for bugs in the joints; iron preferable.

6. Married Quarters.—"Sufficient."

7. Barrack Ventilation.—Holes in ridge, covered by raised thatch. Small windows at top of walls; sufficient at this station, but in other stations have seen it often very imperfect. Cooling by punkahs and tatties; the latter very badly watered, and often quite dry.

8. Drainage.—Trenches for surface drainage. All filth and fluid refuse carried away in tubs.

9. Water Supply.—From canal and wells; soft, good, and very pure; no chemical analysis.

10. Ablution and Bath Rooms.—Lavatories, small tiled sheds, with a wall having depressions to hold basins.

11. Intemperance.—Soldiers generally temperate. Still much disease and crime from drinking of spirits. Sold both in canteen and bazaar. "All spirit "drinking injurious to health." Almost all crime caused by it. Ought to be abolished in canteens and bazaars. At present collectors encourage sale as much as they can, for the sake of revenue. In Burmah, when malt liquor could be had, health always improved. Marked change for the worse when spirit was issued instead. Since beer was introduced, the tremulous, yellow-skinned, emaciated spirit-drinker rarely met with.

12. Hill Stations.—Much approves; but regiments suffering from disease have often had great mortality and sickness on being sent to hills. Would locate entire regiments on hills. Diarrhœa very common. Chief want of hill stations, fresh vegetables and pure water. In rains, water loaded with rotten vegetable matter, causing diarrhœa.

13. Hospitals.—Hospital is a barrack.

Ventilation.—By holes in roof; "sufficient;" no means of cooling.

Cleansing.—Limewashing once a year.

Latrines.—Cleansed by sweepers.

Lavatory.—A small shed; "sufficient;" a bathing tub and foot bath, also "sufficient."

Hospital washing.—By washermen.

Storage sufficient.

Bedding.—Wooden cots, harbouring bugs; iron better.

Cooking.—Kitchen simply a hut; cooks prepare food on ground; "this "arrangement is not good, but we are accustomed to it in India."

Attendance.—Not sufficient; "healthy men are detached for this duty from "the barracks, but they dislike it, and often neglect their patients."

Sanitary state "good."

Convalescents.—No ward; exercise morning and evening, sometimes on elephants; extra dhoolies required.

Female hospital.—One; "sufficient."

Landour.

1. Climate.—No instruments. Mean temperature varies from 44¼° in January, to 73°·18 in June. Rainfall, 92·7 inches. Climate very moist for some months, due to elevation. Diarrhœa (obstinate), dysentery, chest affections of children prevalent.

2. Diseases of Native Population.—Undoubtedly healthy. Small-pox occasional; bad fever, or spleen, only in mountain valleys at a distance; goitre common. Healthiness attributable to pure bracing climate. Natives have inveterate filthy habits; seldom wash or change their clothes.

Landour.

3. Diseases of Troops.—Hill station. Diseases: relapses of fever, intermittent, quotidian, and tertian, contracted in plains. Continued fever from exposure; dysentery seldom, except from relapse; rheumatism occasional; no cholera or small-pox; 12 per cent. of cases sent up are hepatic. *Causes.*—Climate; exposure; dram-drinking. Remedies: plenty of healthy exercise, athletic games, &c.

4. Bazaars and Native Towns.—Small sweeping establishment, paid for by house tax; native houses in cantonments clean; those in the neighbourhood not remarkable for cleanliness.

5. Barrack Construction.—[Convalescent depôt.]

Site.—Open, and beneficially exposed to winds.

Accommodation.—Twelve barracks, 84 rooms; 228 non-commissioned officers and men; 1, 3, 4, and 18 men per room, at from 888 to 1,190 cubic feet per man; 55 to 119 square feet per man; built of stone and lime.

Thatched roofs.

Floors, terraced, a foot above ground; no ventilation below.

Wooden bedsteads: highly objectionable; harbour vermin, accumulate dust and dirt; iron bedsteads the best.

6. Married Quarters.—Married people occupy separate houses. In one or two instances, rooms in barracks, but quite apart from unmarried soldiers.

7. Barrack Ventilation.—Doors and windows; only sufficient for part of the season; no roof ventilation. Barracks not well ventilated and overcrowded.

8. Drainage.—On a ridge. Natural surface drainage sufficient. Every house more or less damp for three months in the year.

9. Water Supply.—Water from wells, not abundant, except in rains; good as to colour, taste, and smell; no chemical analysis.

10. Lavatory and Bath Rooms.—Spacious lavatory, with brass basins in a trough; but from the scanty supply of water in the dry season they are not much used, and the men wash in earthen vessels. Drainage to the slope of the hill.

11. Intemperance.—Spirits sold in canteen, if allowed by surgeon. Extent, two drams a day. In moderation conducive to health. Nothing deleterious to discipline or efficiency in issuing spirits in well-regulated canteens. Health, morality, and discipline very much improved since use of malt liquor encouraged.

12. Instruction and Recreation.—A ball court, four skittle grounds, school room, good library, and theatre. No reading nor day rooms; no soldiers' gardens, no workshops nor gymnasia. No restriction as to exposure required.

13. Hill Stations.—Thinks hill stations, as a rule, should be set aside for sick and weakly men, carefully selected from regiments on the plains, but not for whole regiments. Has been at Kussowlie, Landour, Simla, Subathoo, Murree. Has observed diarrhœa contracted at Kussowlie, where barracks are faulty and overcrowded; patient hardly ever gets well until removed to plains, "and not then, unless disease taken in time." Has known "scorbutic diarrhœa almost decimate a regiment at Kussowlie." Landour remarkably healthy. Thinks service in plains, with short periods in hills, the best; but would insist on numerous sanitaria in hills, with the best possible barracks, &c.

14. Hospital.—*Site.*—Unobjectionable.

Water supply.—Sufficient for culinary, drinking, and ordinary washing purposes; not for bathing.

Drainage.—Natural, on surface. Water runs down steep slopes and ravines.

Construction.—Stone and lime; terraced roof. Verandahs. One floor, raised 2 feet above ground, with passage for air beneath. Built in 1846.

Accommodation.—Four wards, 60 beds; 935 to 996 cubic feet, 53 to 55 square feet, per bed.

Ventilation.—Sufficient, from position of hospital; doors, windows, and ventilators in the wall. No cooling required. Warming by open fireplaces, two in each ward.

Cleansing.—Limewashing twice a year, or oftener.

Latrines.—Drained; never offensive.

Lavatory.—Brazen vessels filled from a trough; portable baths.

Hospital washing.—Done at a distance.

Storage.—Sufficient.

Landour.

Bedding.—Wooden bedsteads; bedding very good. All cots should be of iron.

Cooking.—Means "sufficient."

Attendance.—Hospital serjeant, selected by chance or necessity from the sick men on arrival. A great grievance, repeatedly but fruitlessly represented. Orderlies obtained from barracks. No nurses.

Sanitary state.—Hospital has been remarkably free from disease.

Convalescents.—Wards not necessary. Weakly men carried out in sedan chairs. Little available ground for exercise.

Female hospital.—None; sick obliged to be taken into a spare ward.

Umballa.

1. Climate.—Mean maximum temperature varies from 76° in December to 113° in June; mean minimum temperature 37° in December and January to 76° in June; mean temperature 59°·8 in January to 96°·6 in June; maximum sun temperature, 89° in December and January to 128° in October. Rainfall, 26·3 inches. Climate generally healthy; dry and hot for three months; moist and hot for three months; temperate for two months; cold and bracing four months; neither variable nor foggy; more or less dusty from April till July; debilitating from April till October, during which less animal food and light clothing should be used; flannel required during rains. February most healthy, July most unhealthy month; prevailing diseases, fevers, rheumatism, bowel and liver complaints.

2. Diseases of Native Population.—"Generally healthy." Prevailing diseases: endemic fever, spleen disease; epidemics rare. District well drained by rivers; porous subsoil; few swamps.

3. Diseases of Troops.—Fevers, quotidian, tertian, remittent; dysentery; rheumatism. Proportion of hepatic cases, two to three per cent. of the constantly sick. *Causes* of hepatic disease.—Fevers; exposure; intemperance; too high living; "too much animal food without exercise in hot weather." Proportion of venereal disease to constantly sick, 27·38 per cent. Increase of marriages, Lock hospitals, and inspection recommended.

4. Bazaars and Native Towns.—Large native city three miles from station. Station bazaar regularly laid out in squares. Drainage might be improved. Clean on the whole, but crowded in parts. Defective water supply. Two public latrines; more required; 28 sweepers, paid by inhabitants. Native houses never perfectly clean. Fines levied for nuisance.

5. Barrack Construction.—*Site.*—Much tree vegetation; regulations enforced to prevent its interfering with ventilation.

Accommodation.—2,162 non-commissioned officers and men; from 12 to 66 men per room; 687 to 1,869 cubic feet per man; 51 to 118 square feet per man; four rows of beds between opposite doors and windows, if inner verandahs used as sleeping places; there are actually three rows; no jalousies or jhilmils.

Materials, burnt brick and lime; tiled or thatched roofs; terraced verandahs.

Floors of burnt brick, objectionable; raised 1½ feet above ground; no passage of air beneath; ought to be raised on arches.

Wooden cots, ought to be iron.

6. Married Quarters.—Artillery and foot have sufficient married quarters. Dragoons not quite sufficient.

7. Barrack Ventilation.—By doors and windows only; tolerably efficient; could be improved by ventilators between roof and verandah. Ventilation of tents still a desideratum. Tatties used for cooling.

8. Drainage.—Surface drains of earth; merely kept open and free from rubbish and vegetation. Surface water and drainage from lavatories, baths, cookhouses, &c. "disappears with tolerable rapidity" by drains and by percolation. That from privies, urinals, &c. is carted away. Several nullahs in an unsatisfactory state, permitting water to lodge after rain.

9. Water Supply.—Water supply from wells; not liable to pollution; amount very limited; in hot weather most wells nearly dry; quality pure, as to sensible properties; hard; contains large quantity of carbonate of lime; no chemical analysis; not injurious to health; raised by Persian wheels and by hand; distributed by masonry channels and by carriers.

10. Lavatory and Bath Rooms.—One lavatory for each barrack; water from wells; no baths.

Umballa.

11. Intemperance.—Soldiers temperate; 3 per cent. of admissions caused directly by drunkenness, and 15 per cent. indirectly. Artillery consume three-quarters of a gallon of spirits per month per man; hussars, 1½ drams per day per man; injurious to health and discipline; beneficial to suppress sale of spirits, and substitute beer, tea, coffee, &c.

12. Instruction and Recreation.—Ball courts and skittle grounds. Schools, library, and reading room, well lighted. Soldiers' garden. No day rooms, no soldiers' club, no workshops, no theatre, no gymnasia. Lofty spacious buildings for these purposes would add greatly to health, comfort, and amusement in hot weather. Part of building should be used for games; part for library, reading room, coffee room, theatre, plunge baths. Shade not sufficient. Men confined to barracks from breakfast to 5 p.m., "beneficial."

13. Hill Stations.—Hill stations are highly favourable to troops arriving in health, if lodged in good barracks; unfavourable in some states of disease. Dry, spacious, well ventilated barracks have been the great want of hill stations. Want of vegetables has been productive of much mischief. Approves of hill stations.

14. Hospitals.—*Site.*—Open, freely ventilated, and healthy. That of native infantry hospital near foul nullahs.

Water supply.—"Wholesome, but very limited indeed."

Drainage by surface drains; all refuse water carried away.

Construction.—Hospitals on one floor, raised 3½ feet above ground; no passage of air beneath; built of burnt bricks and lime; thatched or tiled; verandahs on both sides; inner frequently used for sick; built in 1845–6, and 1859.

Accommodation.—31 wards; 356 beds, at from 1,500 to 1,872 cubic feet, and from 72 to 108 square feet per bed.

Ventilation.—Hospitals receive benefit of prevailing winds. Ventilation by doors, windows, and in ridge; "sufficient;" tatties and thermantidotes used for cooling.

Cleansing.—Limewashing once a year or oftener.

Latrines in rear of hospital; shallow cesspits cleansed daily.

Ablution and bath room has brass and earthenware basins along the wall; tubs for bathing. Inexpensive improvements could be made.

Hospital washing done at a distance.

Storage not sufficient.

Bedding.—Wooden bedsteads, tow mattresses, sheets, and country blankets; iron bedsteads required.

Cooking by usual Indian method; "much cannot be said in general in praise "of the cooking, but it is sufficient."

Attendance "ample and liberal."

Sanitary state "satisfactory."

Convalescents.—No wards, but they "would be useful, as enabling the sur-"geon to regulate diet, exercise, and exposure of convalescents." Exercise by carts, elephants, and doolies. No shaded walks.

Female hospital.—In separate buildings. A privy required for each.

Ferozepore.

1. Climate.—Mean temperatures vary in different years; lowest mean maximum in five years, 62° in January; highest mean maximum 115° in June; lowest mean minimum 41° in January; highest mean minimum, 96° in May. Mean daily range varies remarkably in different years, 7° to 34° in same month; highest observed mean daily range, 46° in November 1856; highest mean sun temperature, 130° in July. In five years total rainfall, in October, November, December, 0·2 inch (in December 1858). Monthly rainfall varies in different years from ¼ to above 13 inches in same month. Climate dry, "free from any great "variation" or miasma. Rainfall has been increased by tree planting; climate particularly favourable to health; most healthy, December to March; most unhealthy, August and September; prevailing diseases, intermittent fever, liver disease, produced by exposure to heats and chills from sudden "change of "temperature."

2. Diseases of Native Population.—"Particularly healthy." Prevailing diseases, venereal, giving rise to ulcers, cancers, diseased bones, leprosy, intermittent fevers, calculi. Healthiness attributable to dry atmosphere; absence of surface water and vegetation; pure drinking water; living much in open air.

Ferozepore.

3. Diseases of Troops.—Fever, intermittent; dysentery; rheumatism *Causes.*—Intemperance; exposure; and not soldiers' duties. Hepatic disease not very prevalent. *Causes.*—Exposure to heat; chills; intemperance; dysentery; and fever. 16 per cent. of admissions are venereal cases.

4. Bazaars and Native Towns.—City, 14,000 inhabitants, 2 miles distant. Bazaar not drained; all refuse removed. Water from wells. Latrines only partly used.

5. Barrack Construction.—*Site.*—Open on all sides; receives benefit of prevailing winds.

Accommodation.—948 non-commissioned officers and men.

Barrack rooms.—Length 95 to 100 feet; width, 24 to 44 feet; height, 20 feet; 1,500 to 1,680 cubic feet per man; 75 to 80 square feet per man.

Verandahs.—12 feet wide.

Materials.—Burnt brick and mortar.

Floors.—Brick and mortar, 3 feet above ground; no ventilation below.

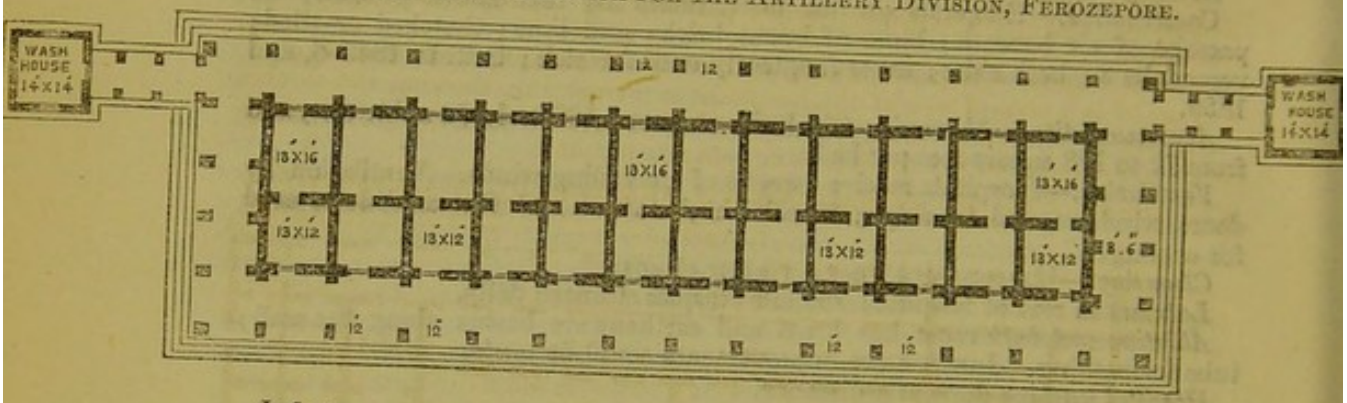
Story.—One; rows of beds between opposite windows, 4.

Bedsteads.—Wooden frames.

6. Married Quarters.—In artillery, families have separated barracks, two rooms and bath room per family.

Fig. 9 shows the plan of these quarters.

Fig. 9.—Married Men's Barrack for the Artillery Division, Ferozepore.



Infantry occupy corner rooms of barracks.

7. Barrack Ventilation.—Ridge ventilation. Skylights or upper windows, "quite sufficient." Cooling by tatties and punkahs.

8. Drainage.—No drainage. All refuse carried off by sweepers. Water from bath room allowed to sink into the subsoil. Refuse from cookhouses received into cesspits 3 feet in diameter, cleansed daily.

9. Water Supply.—Water from wells; remarkably pure, but not free from some combination with earthy matters; soft, sufficient in quantity; raised and distributed in leather bags. No chemical analysis.

10. Lavatory and Bath Rooms.—Lavatories are small rooms with brick and mortar floors, "adapted for receiving and draining off the water into the "subsoil outside, so that the men may freely bathe themselves." Water provided by water-carriers; no bath.

11. Intemperance.—Soldiers generally temperate; from 1 to 2 per cent. confirmed drunkards; spirits sold in canteen. Each man consumes about 6 oz. rum and 1 pint malt liquor, or 3 oz. rum and 2 pints malt liquor per day. Spirits in moderation rather prejudicial by promoting dram drinking in excess. Advantageous to suppress the sale, if other spirits could not be obtained. Moderate use of beer healthy. Tea, lemonade, &c., better than any. If all spirit selling were suppressed, beer, tea, or coffee would materially benefit health. There should be a coffee shop, with reading room and workshops.

12. Instruction and Recreation.—Ball courts and skittle grounds. Schools, library, and reading room, sufficiently lighted. One soldiers' garden, theatre, and gymnasium. No day rooms, no workshops. These latter, with a coffee shop, would be an important inducement for men occupying themselves during the heat.

13. Hill Stations.—Approves. Occasional location every third or fourth season on the hills the best manner of using hill stations.

Ferozepore.

14. Hospitals.—*Sites.*—Open, freely ventilated.

Water supply from wells in hospital grounds.

Drainage.—None; water from bath rooms allowed to sink into subsoil, as also roof water. "Drainage not necessary."

Construction.—On one floor, built of brick and mortar; verandahs. Built in 1846.

Accommodation.—Seven wards, 188 beds, 1,600 to 1,900 cubic feet, and 66 to 72 square feet per bed.

Ventilation.—Prevailing winds admitted; doors 7 feet apart; ventilators in ridge; "sufficient;" punkahs, tatties, and thermantidote used for cooling; warming by ordinary chimney fire-places for wood.

Cleansing of walls and ceilings once a year or oftener.

Latrines.—Same as in barracks; filth removed by sweepers; no cesspits; lime and wood ashes used to prevent smell.

Lavatory and bath constructed in verandah corners; very deficient in infantry hospital.

Hospital washing done in open air.

Storage sufficient.

Bedding.—Wooden bedsteads; bedding as in medical code.

Attendance.—Hospital serjeant and natives; a soldier attends extreme cases.

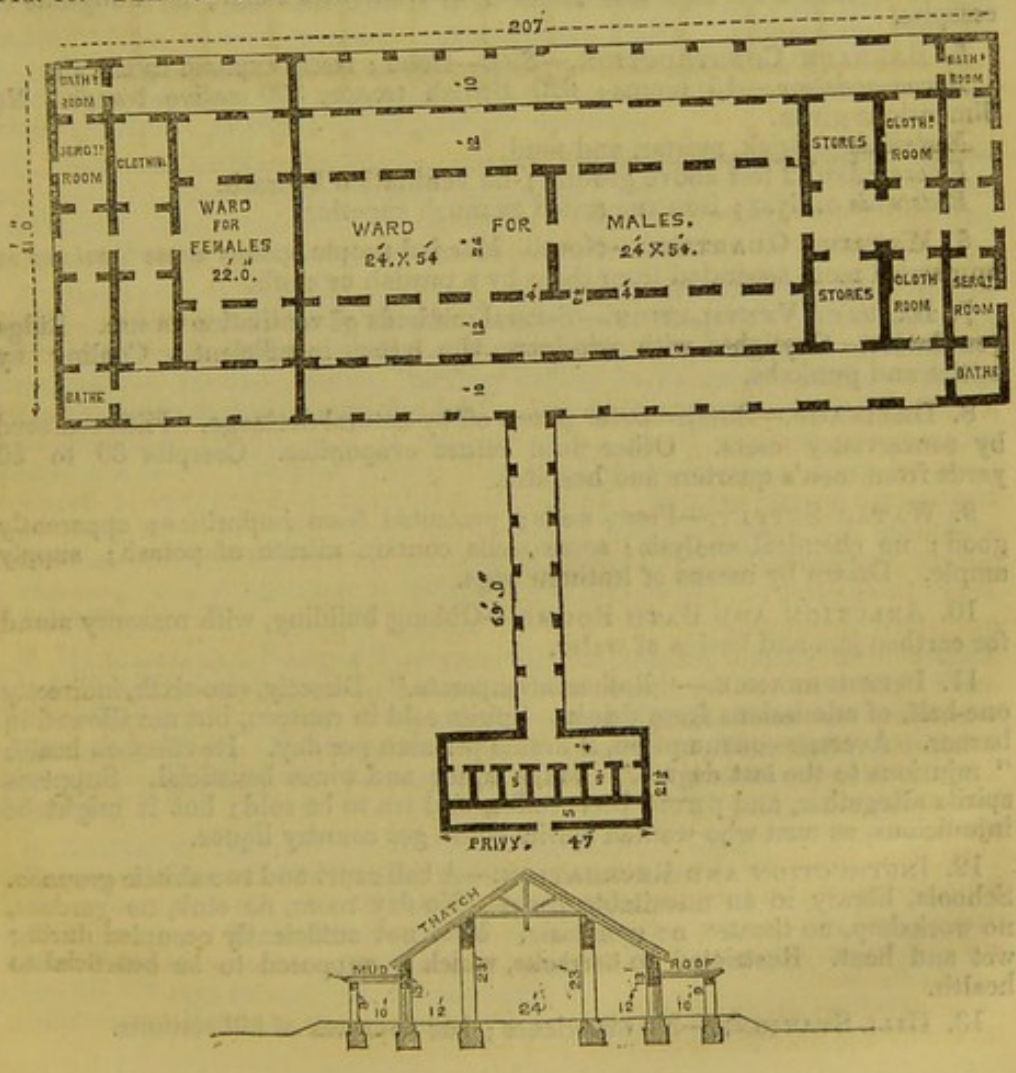
Sanitary state.—"Excellent."

Convalescents.—No separate wards; patients use the regimental garden for exercise.

Female hospital.—Separate wards, with native attendant; "satisfactory."

Fig. 10 is a plan of one of the hospitals at Ferozepore, showing the double verandah construction, the position of the privies, and the provision for sick women and children where there is no separate hospital.

Fig. 10.—Plan of the Hospital for the Artillery Division, Ferozepore.



Umritsir.

1. Climate.—No proper instruments. Mean temperature varies from 54° in January to 88° in August. Mean sun temperature, from 76° in January to 109° in May and August. Rainfall, 44·36 inches. Climate, comparatively very healthy; very dry for many months. Rain, July to September. Heat from middle of April to October intense. In winter, thermometer falls to freezing point. Ice is formed in December and January, sufficient for six hot months. Fogs very rare. No damp, except after rain. Dust storms in hot weather render candles necessary to see with. Sickness increases after first rains. In hot months, animal food once a day only should be given; no spirits and no malt liquor in heat of day. Light clothing, with flannel next skin. December and January healthiest, September and October unhealthiest months, when intermittent fevers, diarrhœa, dysentery, liver disease, and occasionally Asiatic cholera prevail.

2. Diseases of Native Population.—Generally healthy. Prevailing diseases: small-pox; chicken-pox; measles; cholera; intermittent fever. *Causes.*—"Utter ignoring of all sanitary arrangements in city and country;" dirty habits; close, over-crowded, ill-ventilated buildings; exposure to night air; moisture and malaria in rains.

3. Diseases of Troops.—Hepatic disease occasions 4·66 per cent. of total admissions, attributable to intemperance and dysentery; complete withdrawal of spirits from canteens the best prophylactic. Venereal disease is 7 per cent. of constantly sick; increase of marriages suggested; Lock hospitals not recommended. Prevailing diseases: fevers, continued, quotodian, tertian, quartan; dysentery, sub-acute, chronic; cholera; small-pox; rheumatism; admissions from which are 40 per cent., deaths 44 per cent., of total admissions and deaths.

4. Bazaars and Native Towns.—City 1½ miles distant; population 120,000; station bazaar tolerably clean; native houses small; no dunghills or cesspits.

5. Barrack Construction.—*Site.*—Good; freely exposed to the air.
Accommodation.—15 rooms; 620 British troops, 300 native troops. No dimensions given.
Materials.—Brick, mortar, and mud.
Floors raised 2 feet above ground; no ventilation beneath.
Bedsteads of dyar; iron suggested as much superior.

6. Married Quarters.—None. Married people occupy same barracks as unmarried men, separated from them by a purdah or cloth.

7. Barrack Ventilation.—Several methods of ventilation in use. Ridge ventilators. Skylights with windows, the latter insufficient. Cooling by tatties and punkahs.

8. Drainage.—Surface water passes off by natural drainage. Filth removed by conservancy carts. Other fluid refuse evaporates. Cesspits 30 to 50 yards from men's quarters and hospital.

9. Water Supply.—From wells; protected from impurities; apparently good; no chemical analysis; some wells contain nitrate of potash; supply ample. Drawn by means of leathern bags.

10. Ablution and Bath Rooms.—Oblong building, with masonry stand for earthen jars and basins of water.

11. Intemperance.—"Rather intemperate." Directly, one-sixth, indirectly one-half, of admissions from drink. Spirits sold in canteen, but not allowed in bazaar. Average consumption, 2 drams per man per day. Its effect on health "injurious to the last degree." Malt liquor and wines beneficial. Suppress spirits altogether, and permit beer, coffee, and tea to be sold; but it might be injudicious, as men who wanted spirits could get country liquor.

12. Instruction and Recreation.—A ball court and two skittle grounds. Schools, library in an unsuitable room. No day room, no club, no gardens, no workshop, no theatre, no gymnasia. Men not sufficiently occupied during wet and heat. Restricted to barracks, which is supposed to be beneficial to health.

13. Hill Stations.—No experience; but approves of hill stations.

Umritsir.

14. Hospitals.—*Site.*—Healthy.
Water supply.—Abundant and wholesome.
Drainage.—No sewers; refuse water and other impurities otherwise removed; roof water evaporates or is absorbed.
Construction.—Bricks and mortar; verandahs; one floor only; raised 2 feet from ground; no ventilation below.
Accommodation.—Two wards; 20 beds each, at 1,420 cubic feet and 71 square feet per bed.
Ventilation.—Windows, ridge openings, punkahs, tatties and thermantidotes; hardly sufficient; warming in winter months by stoves.
Cleansing.—Limewashing once a year.
Latrines.—"If the filth is removed directly, which it should be, they would "not be offensive."
Lavatory.—Sufficient; a large moveable bath for sick.
Hospital washing by dhobies attached to hospital.
Bedding.—Wooden cots; tow mattresses, &c.
Cooking.—Native kitchen; "sufficient."
Attendance.—"Sufficient."
Sanitary state.—"Good;" no epidemic, "with the exception of cholera," has appeared in wards.
Convalescents.—No wards; would be advantageous only at large stations, where there are general hospitals. No shaded walks.
Female hospital.—A small bungalow; "very unsatisfactory."

Meean Meer.

1. Climate.—No proper instruments. Mean temperature varies from 51° in January to 91° in August, the highest observed mean. Rainfall varies in different years: 9·1 to 21·4 inches. Climate dry. Wet bulb falls 19° in a room in hot weather; wet bulb falls 20° to 24° after rains. Fogs rare. Cold easterly winds in cold weather. Atmosphere dusty. Unhealthy, May to July. Fevers, hepatic, and bowel diseases prevail. September and October also unhealthy. Malarial fevers prevail. Fever begins with hot weather. Heat brings hepatitis; extremes of temperature, dysentery.

2. Diseases of Native Population.—Prevailing diseases: fevers, mostly intermittent; lung diseases; bowel complaints; dyspepsia; acute and chronic ophthalmia; ulcers and boils; rheumatism; venereal. Cheap food and fine climate favourable conditions. Dry seasons most healthy.

3. Diseases of Troops.—Fevers, continued, intermittent, with spleen disease, remittent; dysentery, acute, chronic, hæmorrhagic; cholera, sporadic, epidemic; rheumatism; small-pox. *Causes.*—Heat and extremes of temperature; want of exercise; ennui; sanitary defects in bazaars. Soldiers' health always better under exertion in the field. Average occurrence of hepatic disease in proportion of 3·9 per cent. of total strength. Hard drinkers undoubtedly predisposed to it. Venereal disease 1 in 13 of other diseases. Lock hospital, registration, and inspection have been established. Returns show a diminished per-centage of cases. Another report of later date states that this procedure diminishes the severity, not the number of cases. It is "considered advan-"tageous," but supervision is difficult. It has been "constantly tried in "India."

4. Bazaars and Native Towns.—City of Lahore, 6 miles off. Suddur bazaar, 7,338 inhabitants, nearly 2 miles from centre of cantonments. Four or five other bazaars within cantonments, arranged with broad roads at right angles; kept clean. Drainage about to be improved. Plenty of good water from wells. Three latrines for bazaar, and ten others in different parts of cantonments.

5. Barrack Construction.—*Site.*—Remarkably open.
Accommodation.—2,214 British, 1,365 native troops.
Barrack rooms.—96, with 16 men in each; cubic feet, 1,703 per man; square feet, 72 per man; 96 verandahs, with 8 men in each. Iron-framed barracks, 4, with 52 men in each; cubic feet per man, 1,980; square feet, 80. Dining-room for 104 men in each iron-framed barrack.
Materials.—Burnt brick and lime.

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Floors.—Burnt brick on concrete, raised 3 feet above ground; no ventilation beneath. Burnt bricks are hotter than sun-dried bricks for barracks.

Bedsteads.—Wooden; strong and comfortable. Bedding stuffed with hempen fibre.

6. Married Quarters.—"Sufficient at present."

7. Barrack Ventilation.—By ridge. Swing windows high up in inner walls; sufficient, when barracks not crowded. Cooling by punkahs and tatties. Thermantidotes would be an improvement.

8. Drainage.—Drainage of lines by two shallow "saucer" masonry drains, emptying into roadside drain, 250 feet from each barrack. No drains about the barracks. Water lies for some hours. Lavatory cesspools sometimes overflow, saturate the ground, and taint the atmosphere. These cesspits are from 30 to 40 feet deep, 8 feet diameter, 64 feet from barracks, and 180 feet from wells. Occasionally opened and emptied.

9. Water Supply.—Water from wells; filtered before drinking; not liable to pollution; generally good in quality, but some brackish, saline. 1,000 grs. of water contain carbonate of soda, 0·494 grs.; carbonate of lime, 0·14; carbonate of magnesia, 0·08; chloride of sodium, 0·095; sulphate of soda, 0·178; silica, 0·013; a small quantity of organic matter. Raised by Persian wheel or large skins. Carried in leather skins for use.

10. Ablution and Bath Rooms.—Lavatories 60 feet from barracks, 180 feet from wells supplying water; water conveyed from the well by an underground drain to lavatory, thence supplied by water-taps, and drained away by a drain; bath, a long shallow tank, "in which the men can lie "down and bathe." Larger baths being erected.

11. Intemperance.—Soldiers temperate. Consume a great deal of malt liquor in lieu of spirits. One out of 204 admissions caused by drinking. Amount allowed per man per day, 2 drams of spirits, 1 pint of beer, or 1 dram and 2 pints. Would be more healthy without spirits. It tends to subvert discipline and efficiency. Decidedly in favour of beer in place of spirits; but abstinent man is more enduring of fatigue and less obnoxious to disease than temperate man.

12. Instruction and Recreation.—Skittle grounds. Schools, library, and reading rooms. Several theatres. Billiard room for serjeants. Cricket, chess, backgammon, bagatelle for men. No ball courts, no day rooms, no clubs, no gardens, no workshops, no gymnasia. Photography, modelling, and drawing suggested. No sufficient shade. Double fives court much needed. Men confined to barracks in heat of day. Savings banks have been of greatest use.

13. Hill Stations.—Approves most strongly; but troops have suffered at hill stations from bad barracks, want of sanitary measures, and indifferent rations. Those with organic disease are sure to suffer. Men on arriving are liable to internal congestions, and no hill station has perfect immunity from cholera, bowel complaints, and fevers. Men on returning to the plains suffer from febrile attacks at first, but are afterwards healthier than those who remained on plains. Residence at 4,000 feet safe during whole year; at greater elevations from April till November only. Service on plains, with short periods of residence on hills, would be most healthy.

14. Hospitals.—*Site.*—Two European hospitals on sites open and good One occupies an area of 60,000 square yards.

Water supply.—Abundant and good, from a well within enclosure.

Drainage of wash-houses and cook-houses, either into deep covered cesspools or small shallow reservoirs, whence it is carried away daily; they are close to the hospital; surface drainage by small cut channels for roof and rain water.

Construction.—Solid masonry; floors raised 3½ feet above ground; no ventilation below. Verandahs 10 feet broad; outer ones not used for sick; on one side divided into compartments for wash-houses. "This bad system is detri-"mental to ventilation." Hospital built in 1854–55.

Accommodation.—In E 1 hospital, 10 wards; 160 beds, at 1,728 cubic feet and 72 square feet per bed. Verandahs are occupied by sick on pressure.

Meean Meer.

Ventilation.—Full exposure to prevailing winds; doors, windows, and ridge openings; not sufficient if hospital were crowded; cooling by thermantidotes, punkahs, and tatties. Fire-places for warming.

Cleansing.—Partial whitewashing once a quarter.

Latrines.—Pans and moveable urinals; contents removed twice a day; "not ordinarily offensive, if kept clean."

Lavatories and baths.—In compartments walled off in outer verandah; tables with basins drained into a cesspool. Slipper baths and tubs in hospital for sick.

Hospital washing done seven miles away.

Storage scanty.

Bedding.—Same as in barracks.

Cooking.—Low mud or brick fire-places, with side ledges to support pans and kettles; also brick fire-places; "sufficient."

Attendance.—Hospital serjeant and two orderlies, with ward coolies; "enough."

Sanitary state.—"Spendid and commodious buildings." Improvements in cooling air; in latrines, &c., in progress; ventilation defective.

Convalescents.—No special wards; exercise by carts, elephants and doolies.

Female hospital.—One within each hospital enclosure. Managed like the men's hospital.

Sealkote.

1. Climate.—Mean maximum temperature, from 63° in January to 98° in June. Mean minimum, from 51° in February to 81° in June. Mean sun temperature, 72° in January, 124½° in July. Climate remarkably healthy. Air generally dry, notwithstanding heavy rainfall. Climate variable. June to August very hot. Cold very great December to February. No dust or impurities. A great coat or cloak should be ready at all times. Flannel particularly required. Unhealthy, August to beginning of October. Rest of year healthy.

2. Diseases of Native Population.—"Healthy." Prevailing disease, rheumatism. Except small-pox, epidemics unknown; spleen disease not common. Healthiness attributable to absence of malaria and open dry country.

3. Diseases of Troops.—Fever, ephemeral; dysentery; rheumatism. Typhus or typhoid fever, cholera, small-pox, exanthemata, almost unknown. Less than 3 per cent. of admissions, less than 1 per cent. of deaths due to epidemic and endemic disease. 2 per cent. of cases due to hepatic disease, caused by intemperance or climate. Syphilis occasions a quarter of the admissions. Lock hospitals and inspection recommended.

4. Bazaars and Native Towns.—City 2½ miles from station. Bazaar well laid out. Good natural drainage. Plenty of good water. No crowding. Kept clean by sweepers. Native houses of dried mud. Public latrines provided.

5. Barrack Construction.—*Site.*—Open and freely exposed to the winds.

Temperature raised 2° to 3° by reflected sun-heat.

Accommodation.—1,200 men; 100 men per range; cubic space per man, 1,154 to 1,928 feet; square feet per man, 89 to 102 feet; double verandahs all round; distance between opposite windows, 50 feet.

Materials.—Sun-dried brick; faced with pucka brick.

Roofs.—Thatch and tiles.

Floors.—Brick, 3 feet above ground; no ventilation beneath; 3 rows of beds between opposite windows.

Cots.—Tape and string bottomed; the latter a "vile description of bed," sheltering bugs and all sorts of vermin. Iron bedsteads required.

6. Married Quarters.—Sufficient for all married non-commissioned officers and privates to live separately.

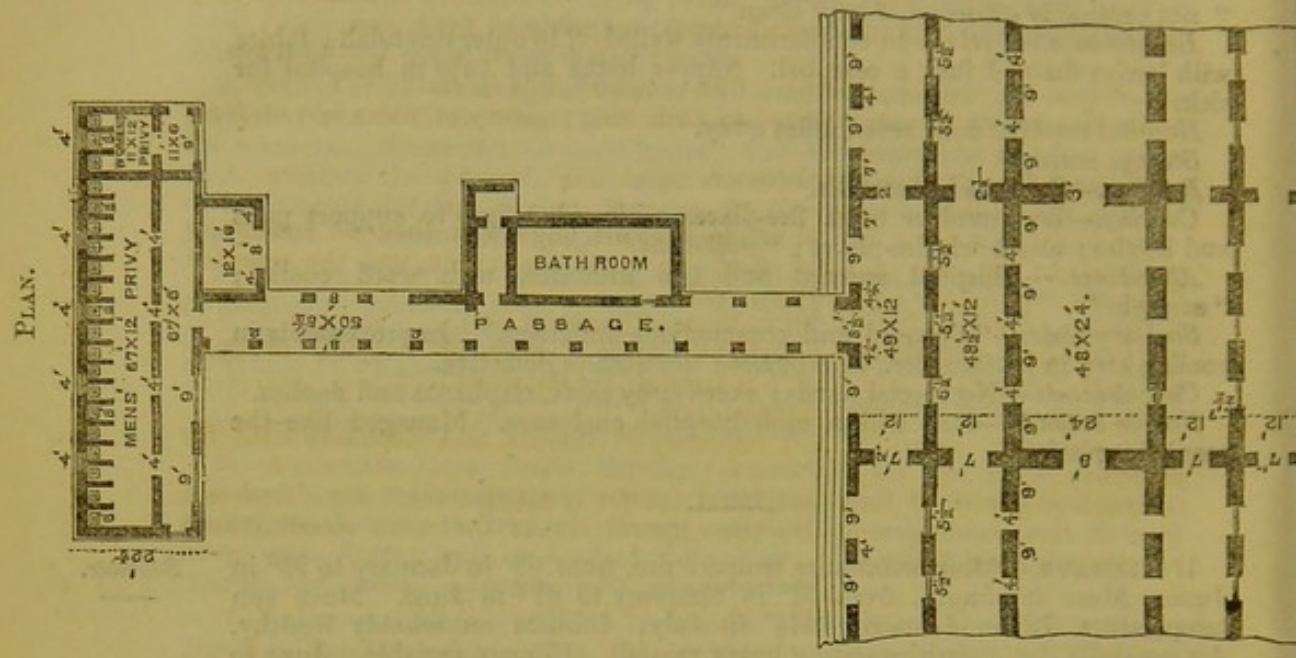
7. Ventilation of Barracks.—Ventilating apertures along ridge, with upper windows, sufficient. Cooling by tatties.

8. Drainage.—By surface channels to the road drains. No sewers or cesspools. Offensive matter removed by carts from the latrines.

Sealkote.

Fig. 11 shows a plan of this class of latrines, and the usual manner of connecting them with barracks. There is no drainage of any kind. All the matter is carried away by hand labour.

FIG. 11.—PLAN OF PRIVY AND BATH ROOM, SEALKOTE, ATTACHED TO BARRACKS.



9. WATER SUPPLY.—Water from wells; not liable to pollution; very pure generally; some wells contain soda; hard, containing considerable proportion of sulphate of lime. "Very free from impurities." "Decidedly good." No chemical analysis; quantity abundant. Raised for use by rope and leathern bucket.

10. ABLUTION AND BATH ROOMS.—Lavatory for each barrack, also three plunge-baths; water from wells; waste water runs into open cesspits, and thence carted away. It is generally used for gardens.

11. INTEMPERANCE.—Temperate; about 3 per cent. confirmed drunkards. Average consumption of spirits, 1 dram a day. Some men never take them. Spirits most injurious to health, and prejudicial to efficiency and discipline; should never be offered for sale, as men are induced to take spirits who never would if they were not so handy. Under no circumstances, except extraordinary fatigue, should spirits be issued; only beer, tea, or coffee should be allowed, and the loss of revenue otherwise compensated for.

12. INSTRUCTION AND RECREATION.—Ball courts and skittle grounds. Schools and regimental libraries. A reading room, very well lighted at night, provided with chess, backgammon, dominoes, and 16 newspapers and periodicals. A soldiers' garden, with seeds and tools provided by Government, who grant prizes for best cultivation. Armourers', saddlers', tailors', shoemakers' and one watchmaker's, shops. Theatres. Cricket and regimental clubs, foot ball and quoits; the latter a favourite game. A gymnasium strongly recommended. Workshops for every trade might be instituted. Savings banks advantageous; that of one regiment has 8,000*l.* Sufficient shade for exercise. Present means sufficient, if properly used.

13. HILL STATIONS.—Troops do better on plains than hills, where station is healthy; they are more efficient and less liable to bowel affections. Where plain stations are healthy, no advantage in quartering troops on hills. Occasional change may benefit a regiment. "It has, however, not yet been "shown that European cavalry corps, never quartered at hill stations, are less "efficient in any way than infantry corps, taking their tour at these stations."

14. HOSPITALS.—*Site.*—Well ventilated and healthy.

Water supply.—Good.

Drainage.—Refuse water and other impurities removed in carts; surface drainage "ample" for removing roof water and rainfall.

Sealkote.

Construction.—On one floor; brick masonry; tiled roofs; double verandahs (inner ones might hold sick, if necessary); floors of brick, raised 3 feet above ground; no ventilation beneath. Built in 1852–53.

Accommodation.—Ten wards; 160 beds, at 1,930 cubic feet and 78 square feet per bed.

Ventilation.—Free exposure to winds; ridge ventilators; windows opening in centre; cooling by punkahs and tatties; warming by fire-places.

Cleansing.—Whitewashing twice a year; four times to the height of 6 feet.

Latrines.—Usual construction; filth removed daily in carts.

Ablution and bath room attached to each wing; plenty of water laid on from wells; baths in each room.

Hospital washing done at a distance.

Storage sufficient.

Bedding.—Wooden cots "which so harbour bugs that they are constantly "broken by the men in their efforts to expel the vermin, and the repeated "repairs required are most expensive."

Cooking.—In kitchens similar to those of barracks.

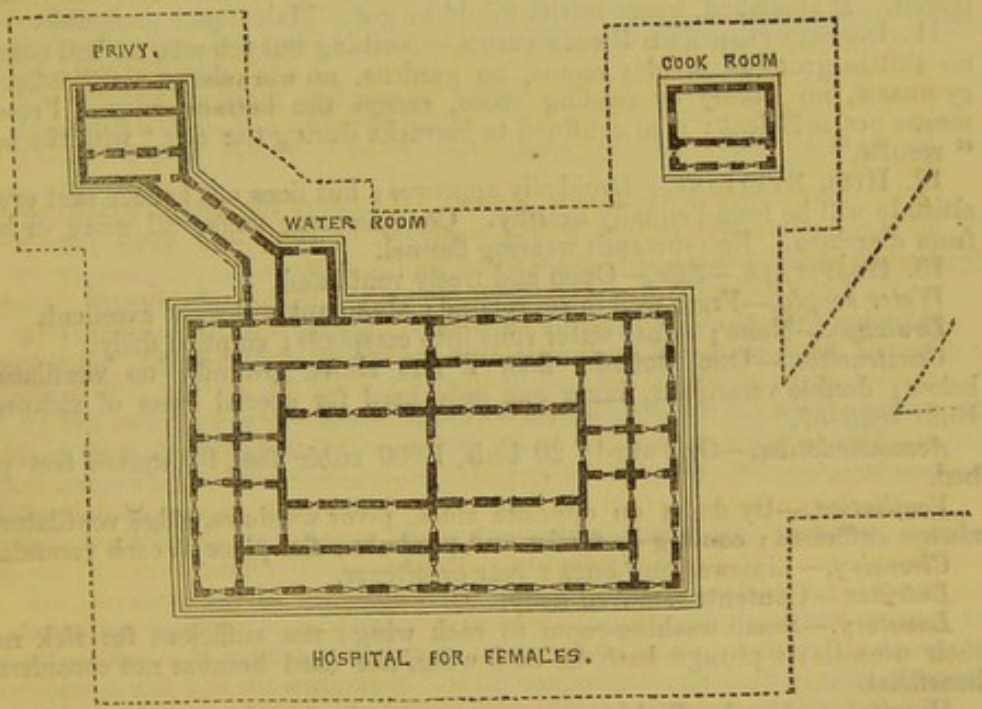
Attendance.—One hospital serjeant; more permanent hospital orderlies required; nurses not employed, but strongly recommended.

Sanitary state.—"Highly satisfactory."

Convalescents' wards.—"Not necessary;" doolies and elephants used for exercise.

Female hospitals.—"Excellent" and "perfectly satisfactory." Fig. 12 gives a plan of this building, and also the construction of the more recent female hospitals in the north-west.

FIG. 12.—HOSPITAL FOR FEMALES, SEALKOTE.



Rawul Pindee.

1. CLIMATE.—No records. Climate decidedly finest in plains of India. Winter clothing, generous diet necessary for seven months; light clothing, less stimulating food necessary for other five, with plenty of vegetables.

2. DISEASES OF NATIVE POPULATION.—Generally healthy. Epidemic small-pox almost every year at beginning of hot season; measles common, and calculus. *Causes.*—Objection to vaccination; want of cleanliness in person, house, and village, hard water.

3. DISEASES OF TROOPS.—Hepatic disease about 4 per cent. of admissions, produced as readily by habitual free living and excess of animal food as by intemperance. Syphilis 16 per cent. of admissions; inspection recommended.

Rawul Pindee. Prevailing diseases: fever, common, continued; dysentery; cholera; rheumatism.

4. Bazaars and Native Towns.—City a mile from station; three villages immediately on outskirts; a new station; bazaar well laid out, free ventilation; surface drains kept clean by sweepers; latrines (at a distance); no dung pits or cesspools.

5. Barrack Construction.—*Site.*—Open; nothing to interfere with ventilation.

Accommodation.—Eight rooms, 24 men in each, each room 66 feet long by 24 feet wide and 24 feet high, exclusive of roof; giving 1,584 cubic feet and 66 square feet per man.

Materials.—Burnt bricks and mortar.

Floors, raised above ground; no ventilation beneath.

Verandahs.—Double; inner one for messing.

Bedsteads.—Wooden, tape bottoms; iron recommended as less likely to harbour vermin; more durable and neater in appearance.

6. Married Quarters.—None as yet.

7. Barrack Ventilation.—Ridge and dormer window ventilation; quite sufficient. Cooling by tatties and punkahs.

8. Drainage.—Trenches for surface water. No sewers. All sewage collected in masonry cesspools, and removed daily.

9. Water Supply.—From wells and river; sensible qualities good; hard; no chemical analysis; quantity sufficient. Raised and distributed by bheesties and bullocks.

10. Intemperance.—Temperate; 7 out of 282 admissions directly, and 1 out of 282 admissions indirectly, from drink. Rum sold in canteen; 2 drams a day allowed. More injurious to health than otherwise. Necessary on a march. If abolished, worse spirits would be got. Malt liquor preferable.

11. Instruction and Recreation.—Nothing but schools, no ball courts, no skittle grounds, no day rooms, no gardens, no workshops, no theatre, no gymnasia, no library or reading room, except the barrack room. Present means not sufficient; men confined to barracks during the day "with the best "results."

12. Hill Stations.—Decidedly approves; but does not believe that every altitude will be found equally healthy. Convalescents suffer all more or less from diarrhœa. Recommends wearing flannel.

13. Hospitals.—*Site.*—Open and freely ventilated.

Water supply.—From well in compound; abundant and most excellent.

Drainage.—None; refuse water runs into cesspools; emptied daily.

Construction.—One storied; floor 2 feet above ground; no ventilation below; double verandahs, inner one only used for special cases of sickness. Built 1853–57.

Accommodation.—One ward; 20 beds, 1,900 cubic feet, 95 square feet per bed.

Ventilation.—By doors on opposite sides, pivot windows, ridge ventilators; always sufficient; cooling by tatties and punkahs; fire-place in each verandah.

Cleansing.—Limewashing once a year or oftener.

Latrines.—Contents removed daily.

Lavatory.—Small washing-room to each wing; not sufficient for sick nor their utensils; a plunge bath in each wing, not used because not considered beneficial.

Hospital washing by dhobies.

Storage not sufficient.

Bedding.—Wooden bedsteads, highly objectionable, cumbersome, unsightly, become filled with bugs, causing loss of sleep and positive injury; iron bedsteads required; bedding suitable.

Cooking.—In ordinary Indian kitchen.

Attendance sufficient.

Sanitary state.—"Good," with the exceptions mentioned.

Convalescents.—No wards; no shaded walks; exercise in doolies.

Female hospital.—A special ward; "satisfactory."

Peshawur.

1. Climate.—Mean maximum temperature varies from 54½° in January to 106° in June. Mean minimum from 41¼° in January to 89° in June. Highest mean daily range, from 4° to 38° in March. Mean sun temperature, from 68¾° in January to 113½° in July. Rainfall varies from 7 to 14 inches. Climate exceedingly trying, great alternations from heat to cold, from dryness to moisture. Tree planting appears to have equalized the temperature. Variableness chief element affecting health. Healthy, December to April. Most unhealthy in September and October, when fevers and bowel complaints prevail.

2. Diseases of Native Population.—Prevailing diseases: fevers, intermittent; bowel complaints; rheumatism; epidemic small-pox; typhoid remittent fever (severe and fatal), epidemic, in certain districts. Spleen disease not common. Streets dirty, houses densely crowded, ill ventilated.

3. Diseases of Troops.—Fevers, intermittent, quotidian, tertian, remittent, continued, occasion 44·9 per cent. of total admissions, and 22·8 of total deaths; dysentery, acute, chronic; cholera; small-pox; rheumatism. Zymotic diseases occasion 51½ per cent. of total deaths. Fevers attended with extreme prostration. Hepatic disease not very prevalent. Abstinence from spirits the best prophylactic. Amount of syphilis, 1 per cent. of strength, 28½ per cent. of sick. Lock hospital recommended.

4. Bazaars and Native Towns.—Large city, 1½ miles from station. Drainage of bazaar like that of station. Ventilation free. Water supply ample. Cleanliness strictly enforced; little crowding; drains not good, but kept clean. Villages round station not dirtier than usual; probably have dungheaps within their enclosures.

5. Barrack Construction.—*Accommodation.*—2,651 British troops.

Site.—Open and freely exposed to winds. *Temperature* raised by reflected sun-heat.

Barrack rooms, 108, with 16 to 24 men per room; cubic feet per man, 1,320; square feet per man, 66.

Verandahs sometimes occupied in winter.

Materials.—Burnt or unburnt brick.

Floors.—Brick, raised 2 to 5 feet above ground; no passage of air beneath.

Bedsteads.—Wooden.

6. Married Quarters.—"Sufficient."

7. Ventilation of Barracks.—By shafts, by ridge and windows, sufficient. Cooling by tatties.

8. Drainage.—No sewers. Offensive matters received into cesspools, 3 feet deep, 3 feet wide, and removed daily. Rain water runs off by surface drains.

9. Water Supply.—Water supply from river Barah by small open canal; stored in tanks, filled daily; quantity about 15 cubic feet per second; colour from suspended matter varies from pale grey to deep red. No chemical analysis. Filtration required.

10. Ablution and Bath Rooms.—No lavatories for European soldiers as yet (August 1860); plunge-bath in each set of lines.

11. Intemperance.—Soldiers temperate; little more than 1 per cent. of admissions directly from drink. Average consumption less than a dram per man per day. Would be unadvisable to abolish sale in canteen, as some old soldiers could not do without it. With sufficient malt liquor, sale of spirits could be suppressed.

12. Instruction and Recreation.—Ball court and skittle grounds. Schools, libraries, and reading rooms, well lighted at night. A theatre. No workshops, no gymnasia, no garden. There should be regimental gymnasia and reading rooms separate from barracks. Men confined to barracks in hot weather from 10 a.m. to 4 p.m. Savings banks highly advantageous. No shade.

13. Hill Stations.—No experience, but approves; and, as a general rule, considers it would be more healthy to locate troops on plains with short service on hills.

14. Hospitals.—*Sites.*—Open; free ventilation; good drainage; no malaria.

Water supply.—Abundant and wholesome.

Peshawur.

Drainage.—All refuse water and other impurities carted away; surface drains for removing rain and roof water.

Construction.—Wards raised 2 feet above ground; no ventilation beneath; double verandahs, inner ones used for sick when necessary; hospital on one floor.

Accommodation.—Three hospitals; 21 wards; 900 beds (including female hospital), at 1,320 cubic feet, and 66 square feet per bed.

Ventilation.—Opposite doors; swing windows; thermantidotes for cooling; fire-places for warming.

Cleansing of walls and ceilings twice a year.

Latrines and urinals.—Same as in barracks; cleansed daily.

Lavatory and bath.—Incomplete and insufficient; no wash-houses; only a portion of outer verandah used; cold baths administered by leather bags or waterpots.

Hospital washing and drying out of station.

Storage crowded.

Bedding.—Same as in barracks, except that a chopped hemp mattress is allowed.

Cooking.—Kitchens, temporary mud buildings without doors or windows; "insufficient," but cooking "sufficient."

Attendance.—Hospital serjeant; native servants; an orderly when necessary.

Sanitary state.—Good, except for ablution.

Convalescents.—No wards required; exercise in doolies or on elephants.

Female hospitals.—Separate buildings, with matron and native female servants; "very satisfactory."

Loodiana.

1. CLIMATE.—No meteorological instruments. Climate very dry; heat very great April to October. Rainfall very variable; nights cold in cold season, sometimes freezing; fogs rare; dust frequent in hot weather; healthiest months, November till April; unhealthiest, August to October. Prevailing diseases; fevers, intermittent and remittent; spleen; dysentery; diarrhœa.

2. DISEASES OF TROOPS.—Fevers, intermittent, quotidian, remittent, occasion 28 per cent. of admissions. Dysentery, acute; rheumatism. *Causes.*—Exposure to sun; lying on damp ground. Venereal diseases 16 per cent. of total sick.

3. BAZAARS AND NATIVE TOWNS.—Town of Loodiana, with 50,000 inhabitants, adjoining station.

4. WATER SUPPLY.—Entirely from wells; kept free from impurities; quality excellent: amount sufficient; no chemical analysis; raised by leather bags, and distributed by carriers.

5. HOSPITALS.—*Site* open, freely ventilated.

Water supply abundant and wholesome.

Drainage by open natural surface drains. All impurities removed by sweepers.

Construction.—One ground floor ward of burnt bricks and lime. Closed verandah all round; used for sick when necessary.

Ventilation by windows and skylights; "sufficient."

Cleansing of walls and ceilings whenever required.

Storage sufficient.

Attendance.—One native doctor, one cooly, one water-carrier, one sweeper, "sufficient for ordinary wants of sick."

Sanitary state.—No epidemic disease has appeared in ward.

Female hospital.—Present arrangement "sufficient," (which means *none*).

Jullundur.

1. CLIMATE.—No meteorological instruments. Climate said to be good. July, August, September rainy season. Other months dry, with occasional dust and thunderstorms. September, October, most unhealthy months. Prevailing disease, intermittent fever. Climate most healthy. Zymotic disease connected with a hot sun and cold damp nights.

2. DISEASES OF NATIVE POPULATION.—"Native population most healthy." Prevailing diseases: fevers; intermittent; dysentery; spleen rare. Healthiness attributable to regularity of rains.

Jullundur.

3. Diseases of Troops.—Fevers, intermittent; dysentery; last year 16 per cent. European, 7½ per cent. native troops, constantly sick with syphilis. Lock hospital and inspection recommended.

4. Bazaars and Native Towns.—City, 3 miles from cantonments. Bazaars generally clean and well drained. Free circulation of air; no overcrowding. Latrines.

5. Barrack Construction.—*Site.*—Open to all winds.

Accommodation.—1,200 European, 3,000 native troops; 16 to 24 men per room; cubic space per man, 1,373 to 1,610 feet; square feet per man, 45 to 75 feet; windows on opposite sides; verandahs all round.

Materials.—Pucka and kutcha bricks, with lime and mud cement.

Roofs.—Thatch, tile, pucka.

Floors.—Brick on tile over concrete, raised 1 or 2 feet above ground; no ventilation beneath.

Bedsteads.—Wood.

6. Married Quarters.—"Sufficient at present."

7. Barrack Ventilation.—By openings along ridge, sufficient. Punkahs and tatties used for cooling.

8. Drainage.—Open suface drains for removing rainwater. Cookhouse refuse carted away. That from privies, urinals, and washhouses received into cesspits underground, 8 inches in diameter, 14 feet deep, "never within" 60 yards of any well, about 50 feet from barracks; cleansed when required.

9. Water Supply.—Water from wells; abundant and wholesome; no chemical analysis.

10. Lavatory and Bath Rooms.—One lavatory for each company; water kept in tubs; no baths.

11. Intemperance.—Soldiers temperate; no confirmed drunkards; spirits sold in canteen. Average consumption less than a dram per man per day. Injurious to health and discipline. Would be beneficial to abolish sale and substitute beer, coffee, tea, &c. Coffee should be issued before morning parade; and beer at dinner and at night.

12. Instruction and Recreation.—Ball courts and skittle alleys. A regimental school, library, and reading room, sufficiently lighted at night. One garden, a private theatre, not in use. No workshops, no gymnasia, no sufficient shade. There are savings banks; decidedly advantageous.

13. Hill Stations.—Disapproves of hill stations generally.

14. Hospitals.—*Site.*—Open and healthy.

Water supply.—Abundant and wholesome.

Drainage.—None; all filth removed in carts; imperfect surface drains for roof water, which is not removed, but sinks into subsoil.

Construction.—Mud walls; verandahs all round; thatched roofs; floors 3 feet above ground; no passage of air beneath. Built in 1847–48.

Accommodation.—Three wards; 58 beds, at 902 to 1,728 cubic feet, and 57 to 72 square feet per bed.

Ventilation.—Free exposure to winds; ridge ventilation; no windows; cooling by punkahs and tatties; "sufficient."

Cleansing.—Walls and ceilings limewashed annually, or oftener.

Latrines.—"Well drained," and "seldom offensive."

Lavatories and baths.—Basins fixed in masonry; "gurrahs for douche baths," and tubs for warm baths.

Hospital washing done by a dhoby.

Storage sufficient.

Bedding.—Wooden bedsteads; "bedding good."

Cooking.—Ordinary kitchen; cooking generally good.

Attendance.—"Sufficient."

Sanitary state.—"Most healthy."

Convalescents.—No wards; "unnecessary." No provision for exercise, except hospital compound, where there is no shade.

Female hospital.—A ward for women and children, "with an ayah when "necessary."

Chunar.

1. Climate.—Instruments imperfect. Mean temperature, from 65° in December and January to 92° in June. Mean sun temperature, from 84° in

Chunar.

January to 120° in June. Rainfall, 47 inches. Climate hot and healthy; hot and dry in hot winds; hot and moist in rainy season; pleasantly cold in cold season; no great variation; little subject to fog and dust. October to half December unhealthiest. Intermittent fever.

2. Diseases of Native Population.—Generally healthy. Fevers, intermittent; small-pox; cholera; spleen. General healthiness attributable to good water; equality of temperature.

3. Diseases of Troops.—Hepatic disease one in 31 cases. *Causes.*—Intemperance and exposure to sun. Preventive, discontinuance of spirits. Syphilis, one in 31 cases; inspection better than lock hospitals. Prevailing diseases: intermittent fever, mostly quotidian and tertian; dysentery (no small-pox); cholera occasional; intemperance, exposure, are the predisposing causes.

4. Bazaars and Native Towns.—Town, 14,000 inhabitants, close to station; many native houses ruinous; bazaar in city kept clean and in good order.

5. Barrack Construction.—*Site.*—Elevated, freely exposed to winds.

Accommodation.—268 British troops, in 25 rooms; with 1,156 to 1,305 cubic feet per man; 43 to 76 square feet per man.

Materials.—Stone and mortar.

Floors.—Terraced or paved; no passage of air beneath.

Verandahs.—Commonly occupied as sleeping quarters in hot weather.

Cots.—Wood and string; cane bottomed cots stronger; more easily kept free of insects.

6. Married Quarters.—Accommodation for 15 married people. Insufficient. Many occupy barrack rooms; some few rent houses.

7. Barrack Ventilation.—Doors, windows, openings in roof; not sufficient. Cooling by tatties and punkahs.

8. Drainage.—No sewers. Open drains 9 to 18 inches wide and deep. Other drainage received into two cesspools; contents taken away in casks night and morning.

9. Water Supply.—From Ganges and wells; quantity inexhaustible, clear, sweet, and inodorous, "if allowed to settle before it is drunk." No chemical analysis; soft; under the microscope shows dust, minute fragments of vegetable matter, and feathers of insects. Drawn from Ganges into leather bags, and conveyed by bullocks and bheesties. Raised from wells by hand labour.

10. Ablution and Bath Rooms.—Lavatory for each barrack except one. Water supplied by bheesties, and runs out through the wall into the drains. No baths. River Ganges used.

11. Intemperance.—Soldiers mostly temperate. One man in 20 a confirmed drunkard. Admissions on a 10 years' average from drink, directly, 1 in 3; indirectly, 1 in 7½ of total admissions. In six years, among 12 total abstainers, no deaths, no crimes. Among 576 temperate men, deaths, 8·84 per cent. of strength; 4·12 of admissions. Crime, 42·01 of strength. Among drunkards, deaths 14·21 per cent. of strength; 8·13 per cent. of admissions. Crime, 426·87 per cent. of strength. Temperate men, with few exceptions, all drink occasionally. Spirits sold in canteen; about two drams per man per day consumed. Impossible to state how much is sold in bazaar. Use of spirits, except in few cases, injurious and most destructive as regards efficiency and discipline. Malt liquor beneficial. Would prohibit sale of spirits, except in certain cases. Discourage by every means men acquiring a taste for it. Would absolutely interdict it on passage out, giving malt liquor instead.

12. Instruction and Recreation.—No ball court, one skittle ground under construction; two schools, a library and reading room, not kept open at night. No day rooms, no clubs, no gardens, no workshops, no theatre, no gymnasia. Present means insufficient. No restriction as to exposure in sun and rain, "men go about at all times, and except when under the influence of "liquor do not appear to suffer from exposure." Shade insufficient. [N.B. The mean temperature of this station is 65° in December and January, and 92° in June; the sun temperature as high as 120° in June, and yet the men do not "suffer from exposure."]

13. Hospitals.—*Site.*—Partially open and freely ventilated only to the north and west.

Chunar.

Water supply abundant.

Drainage.—Surface guttering, with an outlet 30 yards distant; insufficient.

Construction.—Stone and lime; verandahs; inner ones occasionally used for sick or convalescents; building one-storied; floor, 6 feet above ground; no ventilation beneath.

Accommodation.—Four wards, 46 beds, at 1,187 to 1,316 cubic feet, and 68 to 87 square feet per bed.

Ventilation.—No windows; numerous doors, with ridge openings; occasional closeness in hot weather; cooling by punkahs and tatties.

Cleansing.—Limewashing once a year, or oftener.

Latrines.—Fifty feet from hospital; cleansed in the usual Indian way; "not "more offensive than such places are in this country."

Lavatory.—Part of verandah; also serving as bath room; "sufficient."

Storage sufficient.

Bedding.—Cane-bottomed bedsteads; tow mattress, &c.

Cooking.—Indian and English cooking apparatus; cooking properly done, and varied according to order.

Attendance.—Hospital serjeant and usual native establishment; in serious cases "a waiting man from the battalion, who is relieved daily;" not sufficient.

Sanitary state.—"Healthy;" position of latrines and kitchen not good; buildings interfere with ventilation.

Convalescents.—No wards; exercise taken by river side or on ramparts.

Female hospital.—In same compound as male hospital; two wards, "satis- "factory," but a nurse required.

Jubbulpore.

1. Climate.—No information. No instruments.

2. Diseases of Native Population.—Healthy. Fevers, intermittent; spleen; bowel complaints; rapid chest disease; attributable to frequent change of temperature, numberless tanks, large tracts of jungle.

3. Diseases of Troops.—Hepatic disease 2 per cent. of cases. *Causes.*—Intemperance, excessive heat, overcrowding, bad ventilation. Syphilis 34 per cent. to 50 per cent. of cases; impossible to guard against it near large bazaars or cities; Lock hospitals and police regulations recommended. Prevailing diseases: fevers, ephemeral and intermittent; dysentery; rheumatism: no cholera or small-pox.

4. Bazaars and Native Towns.—Town 2 miles from station; drainage of bazaar insufficient; ventilation very bad; water supply good; cleanliness almost impossible; no latrines; every hut crowded; ruinous mud huts, with tiled roofs; no native will keep his house drains clean unless obliged.

5. Barrack Construction.—*Site.*—Shut in by rocky ridges and hills; not freely exposed to wind.

Accommodation.—827 British; 559 native troops: in 10 ranges of barrack rooms; 303½ feet by 20 feet by 17 feet; 1,000 cubic feet per man; 60 square feet per man.

Materials.—Burnt brick and lime.

Roof.—Thatched.

Floor.—Flagged; 18 inches above ground; no air beneath.

Barracks.—Capable of very great improvement.

Verandahs on both sides, used as sleeping quarters when men much crowded, as has been the case since March 1860.

6. Married Quarters.—"Sufficient."

7. Barrack Ventilation.—Ridge ventilation; not sufficient with a hundred men in barrack. Cooling by tatties.

8. Drainage.—Simply open drains. No sewers or cesspits. All refuse carried away.

9. Water Supply.—From wells; abundant, clear, and well-tasted; some wells contain iron; alkaline and soft; no chemical analysis; no microscopic impurities. Raised and carried by bheesties in leathern mussock.

10. Ablution and Bath Rooms.—Lavatories have tubs or half casks for water. Drained into a drain running round building. No baths.

11. Intemperance.—As a rule intemperate. One in 200 a confirmed drunkard. Spirits sold in canteen, and illegally in bazaar. Some men take

Jubbulpore.

one dram, others two per diem. Old soldiers often take a dram before parade; injurious. Highly beneficial to abolish spirits. Malt liquor beneficial. No doubt a cup of good hot coffee most wholesome stimulant for a soldier. Entire suppression of spirits would undoubtedly increase health and efficiency of troops.

12. Instruction and Recreation.—One skittle ground, one school, one regimental library and reading room, one armourer's shop, one theatre. Means insufficient. No sufficient shade.

13. Hill Stations.—Has been in charge at Dugshai. During first season mortality large, more than one-half from hill diarrhœa; worst cases among men who had previously suffered from fever in Peshawur. Excess of cold caused much mortality. Health improved in second year. European troops should be located on well chosen hill stations with short service on plains.

14. Hospitals.—*Site.*—Generally good.

Water supply abundant.

Drainage by open pucka drains. No provision for conveying away the roof water.

Construction.—Unfinished; on one floor; raised 2 feet above ground; no ventilation beneath. Materials, brick and lime. Tiled roofs. Verandahs.

Accommodation.—Three wards, 60 beds; 1,768 cubic feet and 81 square feet per bed.

Ventilation.—No windows; doors half glazed; 15 on each side. A ventilator in each door. Apertures at top of wall and in roof. Sufficient; tatties for cooling.

Cleansing.—Lime washing twice a year.

Latrines connected with a cesspit cleansed daily by filth carts.

Lavatory at the ends of verandahs. Bath room under same roof as latrines, but separated; "sufficient."

Hospital washing done by dhobies.

Storage unfinished.

Bedding.—Wooden bedsteads; iron better.

Cooking sufficient.

Attendance.—Hospital serjeant and two orderlies, increased as required.

Convalescents.—Wards; none, such would undoubtedly be advantageous. Only verandahs for exercise.

Female hospital, none. Treated in barrack rooms. "A most unsatisfactory "arrangement."

Sanitary state.—Hospital incomplete. No deadhouse, &c.

Darjeeling.

1. Climate. — Mean maximum temperature, from 50°·39 January, to 64°·97 August. Mean minimum, 38°·68 January, 57°·97 July. Mean temperature from 45° January to 61°·35 August. Mean daily range between 2°·9 July, and 5°·8 November. Mean sun temperature, between 90° in December, and 104° in July. Average annual rainfall (in 7 years) 124 inches. Climate, temperate and damp; beneficial in debility after fever, or in simple debility. Not beneficial for serious organic disease or rheumatism. Drinking spring water which percolates the decayed vegetable matter produces diarrhœa after first rains.

2. Diseases of Native Population.—Natives generally healthy and strong, living much in open air. Prevailing diseases: small-pox, the scourge of the hill population; fever; sometimes spleen; goître, also common. *Causes.*—Native houses surrounded by all kinds of filth; atmosphere quite sickening in walking through the villages.

3. Diseases of Troops.—Ague; fever, remittent; rheumatism; and dysentery occur, but imported from plains. Never cholera or small-pox. Causes of soldier's diseases in India: monotony, harassing duties, want of exercise and incentives to it, discomfort of overcrowding unhealthy barrack rooms, his condition, generally, leading him to drink; all making him liable to any epidemic or other morbid influence. Means of promoting health, although quite within our reach, have been sadly neglected.

4. Bazaars and Native Towns.—Bazaar well drained; houses too close, mostly built of mats and bamboos; generally surrounded by all kinds of

filth. They are at a distance from depôt; but the medical officer says they are the most filthy villages he has ever entered, and it is quite sickening to walk through them.

5. Barrack Construction.—*Site.*—Open; freely exposed; 7,000 feet above sea.

Accommodation.—For 115 to 120 convalescents, British; 210 native troops.

Three barracks; 2 rooms each, 51 by 21 feet by 14 feet; 18 men per room; with 803 cubic feet and 57½ square feet per man: 28 married rooms. One married barrack, damp on account of situation. The others damp from bad roofs.

Materials.—Brick and mortar, roofs shingle; floors wooden; 2 feet above ground; not very free passage of air beneath.

Verandahs.—Never occupied for sleeping.

Drainage defective.

Cots.—Cane bottom; bedding, hemp.

6. Married Quarters.—Sufficient as regards mere space.

7. Barrack Ventilation.—By doors, windows, and chimneys. No roof ventilation. Not quite sufficient.

8. Drainage.—Open stone drains, by which most of the filth and refuse water are washed away; remainder, including that from privies, carried daily to a distance to cesspits, and earth and lime thrown over. Drainage imperfect.

9. Water Supply.—Abundant supply from numerous mountain springs, some so pure as to be fit for photographic purposes, only containing traces of lime and iron; some contain so much iron as to be used medicinally.

10. Ablution and Bath Rooms.—Eight bath rooms to each barrack. Good water supply from a spring. Refuse water carried off by stone drain.

11. Intemperance.—Soldiers temperate. No admission to hospital from intemperance. Each man not attending hospital, or in hospital, may purchase daily 2 drams rum, or 1 dram of rum and 1 bottle "day." No hesitation whatever in saying that spirits are "decidedly and highly injurious" to troops, and anything but conducive to efficiency or good order. Would be, without doubt, beneficial to abolish altogether the use of spirituous liquors, if done gradually and wisely. The soldier would not be such a drunkard but for his condition. Better that condition, and the British army may become a sober one. Wine, malt liquor, and spirits all injurious in excess. Malt liquor least so. Use of tea, coffee, lemonade, &c., would afford a striking contrast in the result to the other drinks mentioned. There should be restaurants where men could get tea, coffee, newspapers, magazines, and mix with men of other regiments, instead of the discomfort of the everlasting barrack room.

12. Instruction and Recreation.—Two skittle grounds in a very bad state of repair; one school, good library and reading room, two gardens worked by natives. Tailors, shoemakers, tinsmiths work at their trades in barracks; only carpenters have a workshop. A hospital reading room and reader. Means insufficient. Rains fall incessantly for five months, and men are pent up in barrack rooms to the great injury of their health. Different kinds of recreation under cover should be provided for this.

13. Hill Stations.—Approves strongly. No peculiar diseases at Darjeeling. Troops should be located on hills, with short service on plains. Present barrack and hospital accommodation here not sufficient for health or comfort.

14. Hospitals.—*Site.*—Far too exposed.

Water supply.—Good and sufficient.

Drainage.—Not carried far enough down hill. Means of conveying away roof water bad. Surface drainage and guttering insufficient.

Construction.—Brick and mortar; one story; with verandahs.

Accommodation.—Two wards; 34 beds, 1,100 cubic feet and 75 square feet per bed.

Ventilation.—By windows and doors; insufficient light; insufficient ventilation. Warming by fire-places.

Cleansing.—Limewashing once a year; too seldom.

Darjeeling.

Latrines.—Under same roof as hospital; very badly drained; water supply defective; state offensive. Western verandah was used for accommodating sick, when patients obliged to leave wards on account of effluvia from privy. This was shut up "after five years writing about it."

Lavatory.—Close to privy; cold, offensive from its proximity. No fire-place in it. Several men have to wash in same utensil, and to dry with same towel several days running. "In fact, the inducements to remain dirty are, "especially in the case of sickly men, greater than those to be clean." No means of bathing, properly so called.

Hospital washing.—Means sufficient, except during rains.

Storage.—Not sufficient.

Bedding.—No cots; only barrack bedsteads; far too narrow for sick men. Mattresses stuffed with coarse hemp; hard, lumpy, and furrowy. Blankets and pillows very inferior. "Last year's supply" almost all "worm-eaten;" had been previously used in the plains.

Cooking.—Cooks not numerous enough, nor sufficiently paid. Impossible to get anything like a good cook for the trifling wages.

Attendance.—"Sufficient up here," but hospital serjeant and orderlies should be better paid.

Sanitary state.—"Bad."

Convalescents.—No wards. Wards would be an advantage. No provision for exercise.

Female hospital.—None. Women and children treated in their own quarters. Would be satisfactory enough if the married quarters were not so dark and damp as they are.

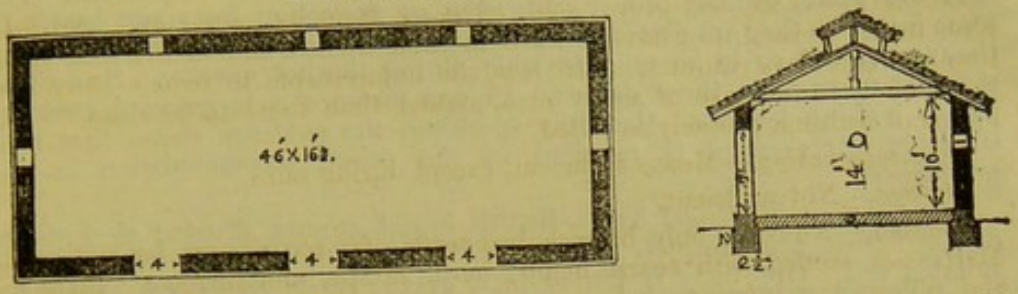
DIET AND COOKING.

1. The ration in the Bengal Presidency consists of bread 1 lb., meat 1 lb., vegetables 1 lb., rice 4 oz., sugar 2½ oz., tea ⅔ oz., or coffee 1¾ or 1⅞ oz. Fire-wood for cooking. The ration is considered complete. Vegetables vary according to season, and consist of potatoes, carrots, onions, cabbages, turnips, sweet potatoes, cauliflower, and pumpkins. A larger supply of potatoes is required, and soldiers' gardens would, it is conceived, enable vegetables to be raised in sufficient quantities. Sometimes there is a scarcity of vegetables, and the men suffer from eating too much animal food. It is suggested in one of the returns, that the diet scale of the navy is much better than that of the army. It consists of from 5 to 9½ oz. of animal food, and 26 ozs. of vegetable food, while the army scale in India contains no leas than 16 oz. of animal food. Sometimes the men purchase milk, butter, fish, eggs, &c., or fruit, when in season. Complaint is made that mutton is not issued often enough, and that the vegetables are inferior in quality. The men have three meals a day; breakfast at 8 a.m., consisting of tea or coffee, bread, often animal food; dinner at 1 p.m., and tea at 4 or 5 p.m.

The cookhouses are small outbuildings at a short distance from the barracks. They are provided with rude fire-places, raised a little above the floor, often dark and badly ventilated. No chimneys, the smoke finding its way out as it likes. There are usually four messes in a company; each mess has one copper boiler of eight gallons, one of seven, and one of two gallons, one frying pan, one gridiron, together with ladles, chopper, baskets, &c. The vessels are usually tinned twice a month. In the hands of native cooks they admit of considerable variety of cooking, such as boiling, stewing, roasting, making curries, &c. The cooking is stated generally to be "sufficient." Native cooks are engaged for the companies. They are paid by the soldiers for cooking, and also for such extras in addition to the ration as they may supply. The ration is counted as worth 3 annas 4 pice, or 5*d.* daily. The kitchens are generally surface drained to cesspits, from which the refuse is carried away daily; or the cesspit is sunk deep enough to be self-draining into the subsoil. Sometimes there is no drainage of any kind, the refuse water being merely thrown out on the surface of the ground. None of the cookhouses appear to have any water supply, except what is carried in skins or vessels by water-carriers.

Fig. 13 gives the ground-plan and elevation of a cookhouse at Benares, and shews the usual construction.

FIG. 13.—COOKHOUSE, BENARES.



DRESS.

There are two kinds of dress in use in the Bengal presidency, one for cold weather, the same as in England; the other consisting of khakee tunic and trowsers, wicker helmet for summer wear. Dress generally considered as suitable for climate and duties. The boots are complained of as being bad. Flannel is considered indispensable. Great coats are used on night guard. Surgeon Major Hare, 2d Bengal Fusiliers, gives in the Roorkee report some interesting information regarding the waterproofing of soldiers' clothing, which is worthy of consideration. At Peshawur a wadded coat is issued for winter wear.

DUTIES.

The routine of duties in the Bengal Presidency varies in different regiments and at different stations. They consist of drills, exercises, and guards; drills occupy one to one and a half hours in the early morning, and half an hour to one hour in the evening; from peculiar circumstances they sometimes do not recur every day. Guards last 24 hours, coming round sometimes every fifth day, giving the men four successive nights in bed, sometimes only once a fortnight, or once in three weeks. With few exceptions, the reporters concur in stating that night guards are not injurious to health, if proper precautions are exercised as to clothing and shelter. From neglect of these, men coming off guard are often found affected with slight rheumatism or bowel complaint. No injury follows night guards properly conducted, even at unhealthy stations. One of the reports indeed states that they are not only not prejudicial, but rather beneficial in hot weather. A few of the reports state night guards to be directly injurious. There is no evidence that the men suffer in health from the usual drills, duties, and exercises, except in the case of raw recruits. Grooming horses is said to be healthy. At all the stations excepting one the practice exists of confining men the whole day to barracks in hot weather; the confinement beginning as early in one case as 6½ a.m., and lasting till the approach of sunset.

PERIOD OF SERVICE IN INDIA.

All the Bengal reports concur in stating that, before a soldier is sent to India, he should be perfected in his drill at home; otherwise he will be sure to suffer from the climate. All the reports, with three or four exceptions, recommend that the soldier should be sent direct from home to India, instead of to any intermediate station. They all concur in stating that none but men whose constitutions are fully formed are fitted for Indian service; and the ages between 20 and 25 are, in general, considered the best ages for beginning such service. They further agree in this important point, that men should be sent from England so as to arrive in India between November and February; there is a general concurrence as to the propriety of exercising great care with recruits on first landing there, and as to sending them direct to their regiments.

There is considerable difference as to the period of useful service a soldier may fulfil in India. The lowest period named is from three to five years; the highest from 15 to 25 years. The opinion in one stational report is that a soldier in India may serve as long as in any country out of his own, provided due care be taken of his health. Under existing sanitary conditions, the prevailing opinion appears to be, that a soldier can serve in India from 10 to 12, or perhaps to 15 years at certain stations.

Invalids leaving India should do so in time to reach England in early summer.

MILITARY PRISONS.

Several of the stations in Bengal have no prison accommodation; or if it exist it is of a temporary character. At those stations where there are prison cells, one-half of them are reported as "good;" and the other half as "bad," or "highly defective." The deficiencies are in construction and position. The cells too small, without proper ventilation or protection from sun heat. In some instances they are placed so as not to receive the benefit of winds; and they are so hot as to be uninhabitable during the hot months. Sometimes sickness arises from these defects. In one instance it is reported that the prison has no latrines. Generally speaking, the evidence shows that considerable improvement is required in the prison accommodation in this presidency.

BURIAL OF THE DEAD.

Every station in Bengal has a British burial ground, situated at a proper distance from cantonments. The grounds are generally well kept, and of suitable soil. One body is buried in a grave; rarely re-opened, except for relatives. One or two of the low lying grounds appear to be wet. But no nuisance or injury to health is ever said to arise from any of them. A burial takes place generally as soon as arrangements can be made, 12 to 24 hours after death. Mahometans bury their dead in separate grounds; generally at a considerable distance from barracks. Their practice of burial is not so careful as that in the British grounds; and sometimes considerable nuisance arises from the dead becoming partially exposed by wild animals or by heavy rains. Near large cities the grounds become at times very offensive; and better regulations on the part of the authorities appear to be called for. Hindoos burn their dead, and throw the remains, more or less imperfectly consumed, into the rivers. The burning ghauts are sometimes too close to the stations, and give rise to nuisance. At other times, the poor merely singe the body, and throw it into the river. Some additional regulation in these matters appears to be required at certain stations.

MORE IMPORTANT NATIVE STATIONS.

Kherwarrah.

Accommodation for seven companies native infantry, one troop native cavalry.

The station is 1,200 feet above the sea; surrounded by hills; open, freely exposed to the winds, which, when from the east, increase the frequency of intermittent fever, influenza, and chest diseases.

Surrounding country partly cultivated and under irrigation, which affects injuriously the health of the station; but it is the abuse, not the use of it which does so. The soil is ferruginous, rich in organic matter, overlying trap rocks.

Water is derived from wells and from the nullah or river. Some of the wells are contaminated by leaves and percolation of foul drainage. Quantity, abundant. Quality, from native wells, semi-transparent, and "not unfrequently "has a fishy taste and disagreeable organic smell." It is always safest, even with the best wells, to boil or filter the water, as guinea worm is very common. No analysis. Water very hard. Raised by hand in vessels. The well in the lines is contaminated by percolation of the foul subsoil drainage from the village and bazaar.

Climate very hot and dry, and comparatively non-malarious from March till June 20th; thence to September 20th cooler, but loaded with malarious exhalation.

Malarious fevers, spleen disease, &c. prevail most in the unhealthy months. But, as a whole, Kherwarrah "is the healthiest station I have seen." "But "none of the stations have had fair play." "Nothing has struck me so much "as the utter disregard which prevails regarding the commonest sanitary pre- "cautions. A large proportion of the sickness at Dumdum, Barrackpore, "Dinapore, Ajmeer, Kherwarrah, is owing to the absence of a properly orga- "nized and efficient executive sanitary department."

Kherwarrah.

There are no barracks; huts of mud or wattle and daub, imperfectly ventilated. Men sleep outside in hot weather. All barracks in India should be raised on arches.

No lavatories or cook-houses. Natives cook their own food and wash their own clothes.

There is no conservancy establishment for cleanliness: "beyond the lines, "this is left very much to the jackal, vulture, and carrion crow." There are patrols to prevent nuisances "except in specified localities." The lines are kept clean; "but the sweepings are deposited 30 yards to windward."

The bazaar main street is kept clean. In all other places the most ordinary sanitary precautions are lost sight of. "Every family has its own cesspool." "Dungheaps close to every hut," and also holes for ordure. Huts overcrowded. "Nuisance is frequently experienced in large stations from the wind blowing "over native dwellings." Animals are slaughtered to windward. The offal is thrown to dogs, jackals, and vultures. During the rains, the stench from the offal, the increasing accumulation of years, is sometimes dreadful. The native population "is decidedly unhealthy, but chiefly from causes which can "be mitigated or removed," such as jungle, marshy and swampy ground, small, cramped, damp, and unventilated dwellings, defective clothing, bad food and water, sheltering cattle, sheep, and goats under the same roofs as themselves, neglected cesspools, middens, exuviæ of men and animals, absence of drainage, opium eating, spirit drinking, &c.

Prevailing diseases among natives are malarious fevers, splenic enlargement, splenic cachexia, diarrhœa, cholera, small-pox, guinea worm.

Among the native troops hepatitis is rare, 35 cases and 1 death in 17 years. In the same period one in every six men suffered from guinea worm, caused by bad water. "Drinkers of pure water never get the disease." The troops suffer from quotidian, tertian, quartan, remittent, and typhoid fevers; acute and chronic dysentery; sporadic and epidemic cholera; simple and confluent small-pox; acute and chronic rheumatism. Fevers alone constitute nearly 40 per cent. of the admissions and about a fourth of the deaths. Cholera has occasioned 26 per cent of the deaths. "We shall never arrive at "sanitary perfection in Indian military stations until sanitary officers are "vested with liberal, responsible, well defined executive powers."

Hospital.—Open site, with free ventilation and natural drainage. But malaria emanates from the nullah or river, 30 yards to windward.

Water supply abundant, but requires boiling and filtering. No drainage.

One ward, built of sun dried bricks and mud.

Tiled roof, through which hot air and radiant heat enter freely.

A verandah surrounds it.

There are 56 beds, at 327 cubic feet and 25 square feet per bed. 32 beds are kept in the verandah to diminish the overcrowding.

No windows; only doors on opposite sides, which, with openings in the tiles afford ventilation.

Privy of sun-dried bricks; kept clean; matter removed in earthen vessels; charcoal used.

No lavatory.

"Each patient defers bathing, according to custom, till he is cured, when "he retires to the nearest well, draws water, and undergoes the bath of cure." "It is a bad custom." There should be a good bath room. Linen is washed and dried by caste comrades, or by the patients, when not too ill. There are wooden bedsteads. Each sepoy brings his own bedding, under direction of the surgeon. There is a kitchen, but the patients or their friends cook outside, under the nearest tree. No diet table. Dooly bearers wait on the sick, but their attendance cannot be exacted by regulation. Comrades are allowed "in "extreme cases."

By unremitting exertion the sanitary state of the hospital is good, but during the past two years gangrenous and spreading sores have been frequent from overcrowding.

Sick wives and families are treated in their own huts.

Seetabuldee. Number of native troops —

Artillery, 16 officers, 122 privates.
Cavalry, 54 officers, 480 sowars.
Infantry, 96 officers, 800 privates.

Surrounding country hilly, basaltic, dry, 939 feet above the sea; freely exposed to winds. City of Nagpore two miles distant.

Climate good. Hot from March till June; wet till end of September, cool afterwards. Fevers prevail after rains. Hot season the most healthy.

Water supply from wells, moderate in quantity, said to be good; raised by a rope and native bucket.

Bazaars cleansed by sweepers. "A sanitary police to prevent nuisance "would be of great use." Population at Nagpore unhealthy. Severe epidemics of cholera, biliary remittent fever, and small-pox often occur and prove fatal to large numbers of the inhabitants. Intermittent fever and dysentery also common. Causes: defective ventilation, insufficient drainage, overcrowding, want of cleanliness, drunkenness, and the use of bang and opium.

During five years, out of 640 sick of native troops in artillery hospital, not a single case of hepatic disease has occurred. In cavalry hospital, out of 3,054 cases there were eight of liver disease; when it occurs it is usually the consequence of fever and dysentery. 8·28 per cent. of the cases in artillery from venereal. In the cavalry nearly 3 per cent. In the infantry 1·47 per cent. Remittent and intermittent fevers are endemic among the native troops; biliary remittent, epidemic. Dysentery, endemic. Cholera and small-pox, epidemic. Intermittent fever causes 31 per cent. of the admissions and 13 per cent. of the deaths. Remittent fever little more than 1 per cent. of the admissions, but 6½ per cent. of the deaths. Nearly 22 per cent. of the deaths are due to cholera. Zymotic diseases occasion 45½ per cent. of the mortality. Severe night duty quickly increases the number of sick in hospital. Predisposition to these diseases increased by the use of bang and opium. This should be prohibited. Infantry parade ground should be drained, and the "natives compelled to "proceed to a greater distance for the purposes of nature."

Hospitals, three, one for each arm. Sites of cavalry and artillery good. Parade ground in rear of infantry hospital almost a swamp in rainy season.

Accommodation consists of four wards, with 102 beds, 30 of which have 706 cubic feet per bed. The remainder have 1,080. No windows. Roof ventilators and gratings. No drainage. Privies cleansed by sweepers. No lavatory or bath.

Chirrapoonjee. Head quarters of Sylhet light infantry.

Situated on a small table land, surrounded by hills and valleys covered with dense jungle. Elevation 4,118 feet above the sea, 3,000 feet above a glen to the east. Surrounding country mountainous, sandy, and swampy. Station freely exposed to winds. Surface generally rocky. Subsoil sand, clay, and gravel. Rainfall generally runs away, but sometimes lies on the surface.

Barometer varies between 25½ and 26 inches. Highest mean maximum temperature 73°·83 in May. Lowest mean minimum 50°·1 in February. Diurnal variation from 4°·8 to 16°·33 F.

Highest mean sun temperature 91°·25 in July.

Moisture excessive during six months of the year. Recorded rainfall for one year, 1859–60, 615·26 inches. Of this amount nearly 21 feet fell in the month of June. Climate cold but invigorating. Native troops and European residents very healthy. Want of shelter and severe storms render persons who come from the plains liable to chest affections. Good shelter and warm clothing are necessary.

The sepoy huts are built of stone and mud, thatched with leaves, and raised from 2 to 4 feet above the ground. The natural drainage good. But all the buildings are damp from the moist (not to say wet) atmosphere.

Water is obtained from mountain torrents, said to be of the best kind. A large pond, formed from damming up a mountain stream, emits unpleasant smells.

Chirrapoonjee.

No lavatories. Men wash in the streams. No cook-houses. All filth washed away by the rains.

Bowel diseases are prevalent among the Khasia Hill people. Small-pox and cholera are the chief epidemics, committing great ravages, caused by the very filthy habits in houses and persons, and by the very bad food. The native troops suffer from intermittent fever, diarrhœa, and dysentery, contracted during their periodical change of stations.

The best seasons for residence at Chirrapoonjee are spring and autumn. Great care is necessary in the rains. Liver disease very rare among native troops. Very little venereal disease. Six out of every seven admissions from miasmatic disease are caused by intermittent fever. The sepoys are temperate. No admissions, either directly or indirectly, from intemperance.

Hospital, 200 yards from the lines. Site good. Water abundant. Natural drainage sufficient. One ward for 50 beds, at 490 cubic feet and 17 square feet per bed. Ventilation by doors, windows, and fireplaces; not sufficient. Privy a mere mat house, with earthen pots. No lavatory or bath arrangements. Water is carried to the sick by the water-carrier. Surgery and storage damp. No diet tables for the sick.

MADRAS PRESIDENCY.

TOPOGRAPHY AND MORTALITY.

Replies to the questions issued by the Commission have been received from 49 stations in the Madras Presidency and its dependencies, at 29 of which there is accommodation for European troops.

A number of these were occupied solely by native troops at the time the returns were made.

The following abstract is confined to the more important stations where the largest number of European troops have been located.

The lowest stations are *Fort St. George* and *Poonamallee* on the level of the sea. The highest occupied purely as a military station is *Bangalore*, 3,000 feet above the level of the sea.

There are two hill stations, *Ramandroog* and *Wellington*, the former 3,300, the latter 6,000 feet above the sea.

About 8,500 men are barracked at elevations between the sea level and 1,000 feet above.

About 4,500 are placed at heights between 1,000 and 1,800 feet. Nearly 1,700 are barracked at *Bangalore*, at an altitude of 3,000 feet, and about 1,000 at the two hill stations.

The seaside stations of *Fort St. George*, *Waltair*, and *Vizagapatam* occupy sandy soils; the last is on a swampy tidal estuary.

The barracks and hospitals at *St. Thomas' Mount* are close under the hill, which rises 180 feet above them.

The higher stations are on granite and trap rock, sandstone, and limestone.

Bangalore is an undulating sandy table land, partly swampy.

The Neilgherries in the neighbourhood of *Wellington* are mountainous, and consist of schists and basaltic dykes.

The plain at *Poonamallee* is under water in the rains.

Rangoon and *Tonghoo* are both situated in low, jungly marshy districts.

In many parts of the Madras Presidency there are districts of country of a healthy character, and possessing climates similar to the best of the south of Europe. Very few of the climates of existing stations are reported as unhealthy, while many are considered as decidedly conducive to health.

Stations.	Elevation above		Accommodation for British Troops.	Actual Occupation.	Mortality per 1,000 per annum British Troops.		Remarks.
	Sea.	Country.			Total.	Miasmatic Diseases.	
	Feet.	Feet.					
Madras - - Fort St. George	0	0	1,030		34·69*	16·21	Flat; sandy; dry; clay; resting on primitive formation.
St. Thomas' Mount.	60	18	600		38·6		Open; small hills; numerous tanks; St. Thomas' Mount rises close behind barracks, and 180 feet above parade, impeding ventilation and increasing heat.
Arcot - -	550	30	366				Partly cultivated; sandy; dry, broken ground, flooded in monsoon, producing malaria; quarter of a mile from river Pallar.
Vellore - -	675	0		248			Hilly; alluvium; part swampy; primitive rocks.
Bangalore -	3,000	0	1,689		23·69*	12·69	Undulating; sandy and dry; part swampy in rain.
Secunderabad	1,800	various	1,961	2,978	59·74		Undulating; rocky; large tanks; granite and sand.
Vizagapatam -	10	0	310	310			On sea-shore; close to tidal marsh; alluvium and gravel.
Waltair - -	200	150					Sand hills, with deep, clean, dry ravines; close to sea.
Bellary - -	1,600	60	1,038	1,084	48·6		Undulating: dry; black soil; granite.
Trichinopoly -	250	+	1,095		31·07		Alluvial; granite and trap rock.
Cannanore -	20	0	1,094		21·25*	8·86	On the sea-coast; laterite with red gravel.
Ramandroog -	3,300	1,000	50				Hilly; covered with jungle; a table land; scanty water supply; exposed to winds; no cultivation.
Kamptee - -	900	0	1,396	1,396	37·26*	23·45	Flat; black soil; wet in rains; sandstone and limestone.
Jaulnah - -	1,652	—	427		10·3		Hilly; trap rock; red and black soil.
Poonamallee -	2	0	600		89·55*	69·65	Plain; under water in monsoon; sandy.
Wellington - (Jackatalla) -	6,000	5,000	907		39·11*	21·93	Mountainous; schists; ferruginous clay; basaltic dykes.
Rangoon - -	80	70	1,150	1,033			Flat; jungly; swampy; clay; sandstone; laterite.
Tonghoo - -	300	35	1,160	681			Flat; marshy; jungly; red sand; clay; laterite; iron ore.

* The mortality for the Madras stations is taken partly from the mortality returns for Queen's infantry in the folio Report. The instances in which this is done are marked.* The mortality of the other stations refers partly to Queen's, partly to British troops of the Indian army, and is taken partly from Sir Alexander Tulloch's evidence, partly from the report of Inspector-General Pearse (Appendix, folio Report).

Stations for British Troops.

Madras. Fort St. George.

1. Climate.—On the whole favourable to health. From November to February cool, dry, pleasant. Temperature 76° to 78° F. Air moist in May and October. Maximum temperature in May 99°. Minimum in December and January 65°. No violent changes. Heavy dew in December and January with fog 2 or 3 feet above the surface. Air always damp during long-shore winds. Dusty during north winds. Dysentery during October rains. He-

patitis and fever in hot season. January and February the most healthy months; August and September the most unhealthy.

2. Diseases of Native Population. — Continued fevers, diarrhœa, dysentery. Cholera, a few cases, almost daily among natives; occasionally epidemic. Natives who cannot work, generally poor and unhealthy from bad and insufficient food, and are obliged to live in lowest and worst drained locality.

3. Diseases of Troops. — Continued fever, dysentery, hepatic disease. Shelter from sun and moderation in eating and drinking the best preventives for hepatic disease. Sanitary improvement of town recommended.

4. Bazaars and Native Towns. — Most offensive effluvia from river Kooum, which "probably" predispose to disease among those exposed to their influence. Air in Black Town and Triplecane loaded with mephitic effluvia at night. Fort bazaar small, clean and well ventilated. Bazaars at Perambore and Vepery not well cleaned. Atmosphere around "perfectly poisoned." Drainage very bad.

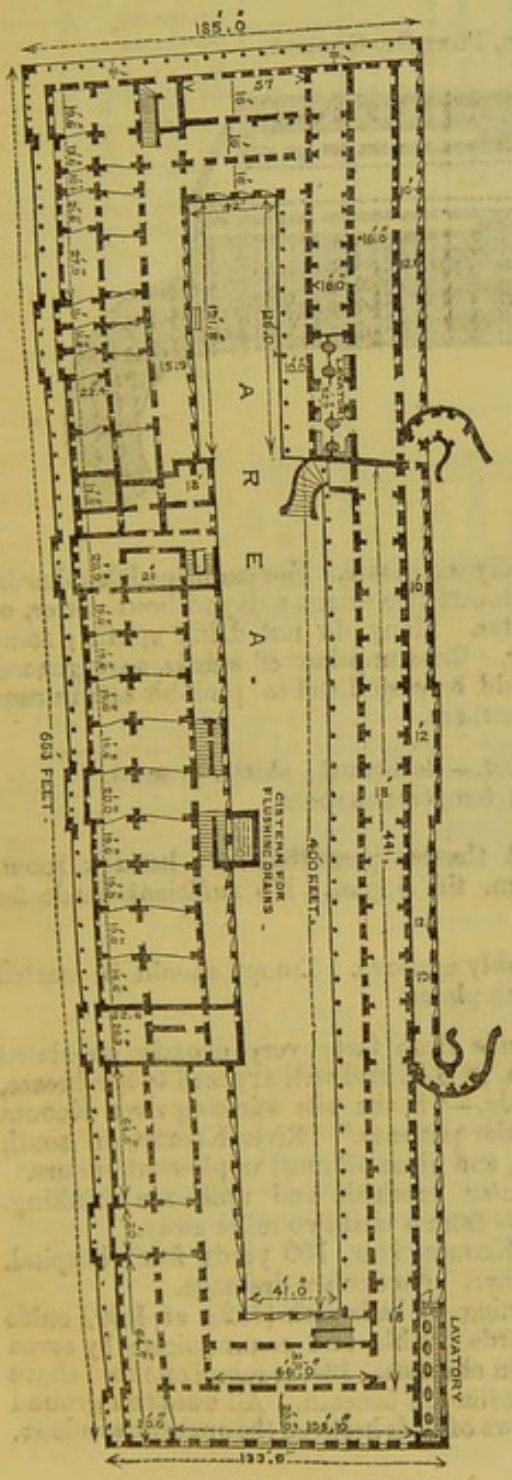


Fig. 1.—Plan of the Barracks, Fort St. George.

5. Barrack Construction. — European barrack, contains 2 rooms; lower 1,483 feet long, 18 feet wide, 15½ feet high; upper, is stated at no less than 2,124¾ feet long, 20 feet wide, 14½ feet high, and contains above 600 men. These two rooms accommodate 1,030 men, at 1,000 cubic feet and from 64 to 69 square feet per man.

Materials, brick and mortar.

Floors of square brick and teak; those of the lower story of granite, raised from 2 to 4 feet. No passage of air beneath.

Iron bedsteads.

Fig. 1 shows the groundplan of this barrack.

6. Married Quarters.—There are 81 married quarters in the patchery, and 10 in the barrack square, making 91, instead of 150 as required for a full regiment. Recently a regiment had 126 families, and the number over 91 had to be accommodated in barrack rooms.

7. Ventilation of Barracks. —By opposite doors and windows. Venetian shutters to upper floor. Earthen tubes in roof. Half doors, generally open night and day. Punkahs for cooling. Huts not ventilated.

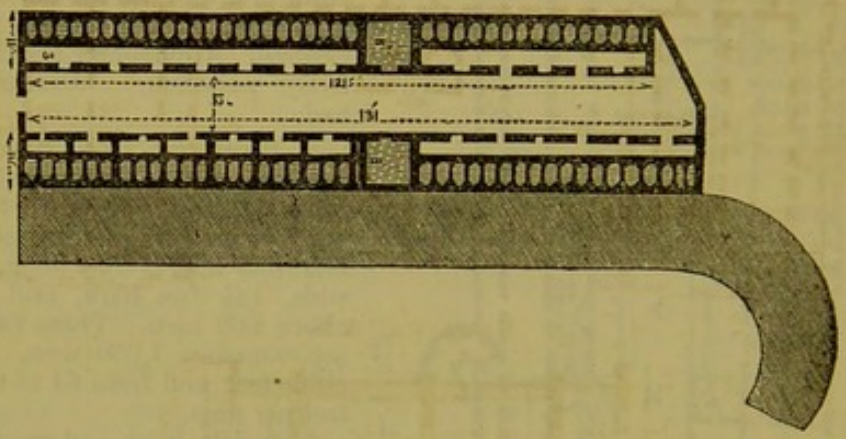
8. Drainage. — Fifty thousand rupees lately sanctioned for improving drainage of Fort St. George. Old privies "as bad as they well could be;" new ones being constructed. Arrangements at native lines, as described, simply abominable. Drainage in the proper sense cannot be said to exist; such as it

Fort St. George. is, it is worse than useless. "No cesspits within the fort of any consequence." Main drain of town 80 yards distant. Effluvia from it very offensive, with north-east wind.

9. Water Supply.—Water brought in pipes from Seven Wells, two miles distant, to covered cisterns in the fort. Native supply from wells and tanks. Some of it brackish, especially in Black Town. Almost all tank water has a disagreeable smell. Quality said to be "good." No chemical analysis.

10. Ablution and Bath Room.—"Excellent and abundant baths and "wash-houses:" 82 baths and two lavatories for men, and 19 baths and two lavatories for women and children. Water laid on. All well drained through latrines to sea. Fig. 2 shows this bathing establishment, which is the best in India.

Fig. 2.—Baths, Fort St. George.



11. Intemperance.—Troops usually temperate. Few confirmed drunkards. Spirits sold in canteen. Each man allowed two drams a day without porter, or one dram a day with one quart porter. Many do not drink spirits; some only a portion, and only after dinner. Consumption of spirits, as a general rule, considered injurious; but it would be prejudicial to prohibit sale in canteen; men would get worse spirits elsewhere.

12. Instruction and Recreation.—Ball court; skittle ground.
Schools, library, and reading room; temperance room.
"No space for soldiers' gardens."
No gymnasium nor workshops. A theatre permitted in a barrack room. Men confined to barracks from 7 a.m. till 5 p.m. No sufficient shade for exercise.

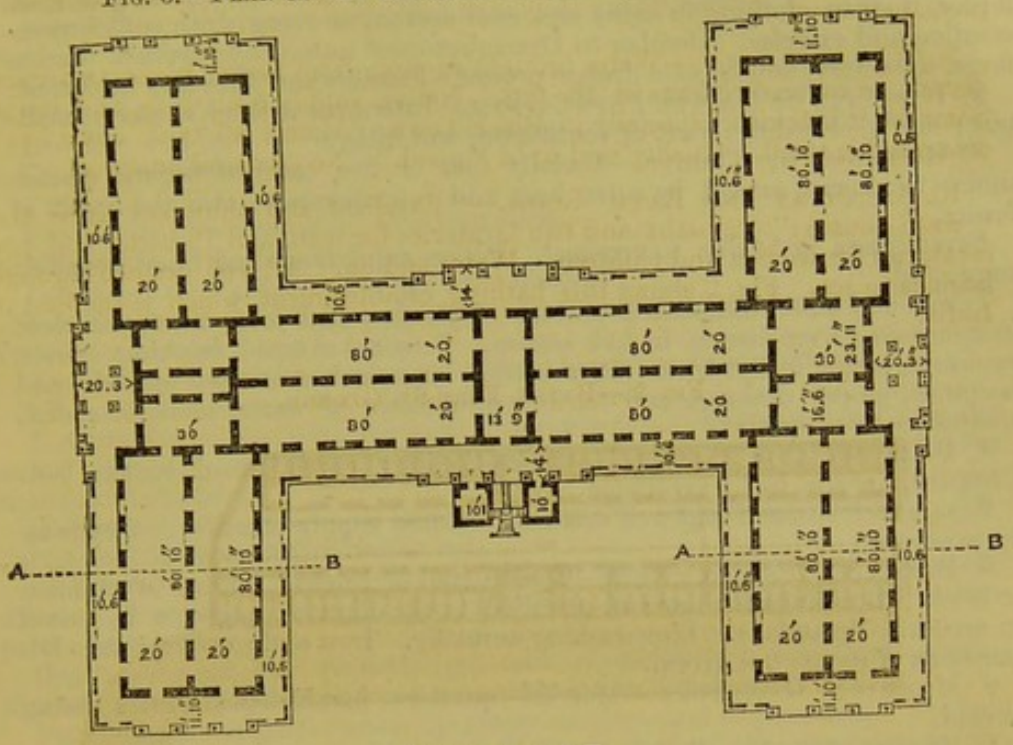
13. Hill Stations.—Unquestionably approve. Troops should be located on hills, with short periods of service on plains.

14. Hospitals.—*Site.*—Half a mile from fort; very densely populated village on opposite side of road; open to S.E. and well exposed to sea-breeze, to which the Commander-in-chief adds,—"if the vile stinking river Kooum "were not under the very noses of the patients." River Kooum, on south and west sides, receives town drainage, and gives off most unpleasant odours.
Water supply.—Hospital well water brackish and unfit for drinking. Good water has to be brought in barrels from a well two miles away.
Drainage.—Two drains, outlet in Kooum river, 100 yards from hospital. No provision for carrying away roof water. No surface drainage.
Construction.—Twelve wards, containing 16 beds each (192), at 1,397 cubic feet and 101 square feet per bed. Wards double, and communicate by seven arches along the side. Materials brick in chunam. Floors raised one foot above the ground; they are of brick. No ventilation beneath. All wards on ground floor. Wards back to back with four rows of beds between the opposite windows. Verandahs 10 feet wide.

Fort St. George.

Fig. 3 shows the construction of this defective building.

FIG. 3.—PLAN OF THE GENERAL HOSPITAL, FORT ST. GEORGE.



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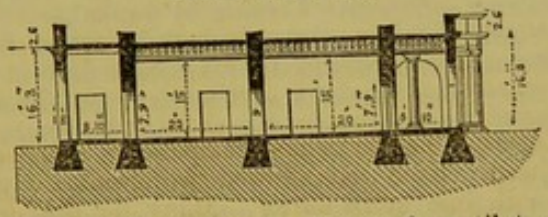


Ventilation by doors and windows. No roof ventilators. Air cooled by punkahs.

Cleansing and limewashing twice a year, or oftener if necessary.

Latrines.—Placed to windward "unfortunately." "Tubs only are used." No urinals or waterclosets. Privy washed daily, and "charcoal burned in it," "not offensive." An opinion in regard to which the Commander-in-chief says, "a year ago it was odiously offensive."

Lavatory and bath.—Three rooms with brass basins and stands. Baths are large tubs for cold and warm water. Shower bath and douche.

Storage sufficient; but considerable improvements might be made with advantage.

Bedding.—Wooden and iron cots. Bedding of good quality.

Cooking.—Similar means to those recently introduced in barracks, promise to act well.

Attendance.—Hospital serjeant, male coolies, orderlies when required; "suffi-
" cient."

Convalescents.—No wards. Not sufficient exercising ground. Men conveyed in doolies and bullock carts to the sea beach morning and evening.

Female hospital.—A detached ward. Midwifery cases taken to lying-in hospital. Arrangements not satisfactory.

Sanitary state "good." Cases of cholera have appeared, when disease was in Madras. Ulcers have once in five years shown tendency to gangrene, when whitewashing has been neglected.

St. Thomas' Mount.

1. CLIMATE.—No observations. Climate dry for at least nine months. Hot all the year round, varying from 71° minimum to 95° maximum. Heavy rains in October and November. Average annual fall, 30 to 40 inches. Climate equable. Fogs rare. Damp at times. Effect on health debilitating

St. Thomas' Mount.

from excessive heat; best precautions against which are moderate diet (animal and vegetable), total abolition of spirituous liquors, moderate quantity of malt liquor, woollen clothing in rainy and cool season, morning drill, sufficient recreation and exercise. October to December most unhealthy months. Severe fever, dysentery, and hepatic disease prevail. January and February healthiest.

2. Diseases of Native Population.—Intermittent fever, cholera, small-pox; due to crowding, want of ventilation, and filth.

3. Diseases of Troops.—Usually four or five cases of hepatic disease under treatment, caused by solar heat and intemperance; also the result of fevers.

Seven cases in 54 due to venereal. Police regulations and Lock hospitals suggested.

Fevers and bowel complaints prevail. Dysentery and fever most prevalent in monsoon; liver disease in hot season. Personal causes: drinking spirits, exposure, eating unripe fruit. Preventives: large, well-ventilated barracks and hospitals, proper drainage and latrines, abundance of water, wholesome diet, abstinence from spirits.

4. Bazaars and Native Towns.—Sanitary condition of bazaar bad. Crowded, narrow, badly ventilated.

Bazaar well situated and well drained. Water supply plentiful. Cleansing by sweepers.

5. Barrack Construction.—Constructed of bricks. Floors of chunam or brick. Buildings too low and unsuited to the climate; ought to be raised on arches. Verandahs. Limewashing annually. Iron and wooden cots. Dimensions of rooms not given.

6. Married Quarters.—Married quarters insufficient; others being erected.

7. Ventilation of Barracks.—By an opening in the roof. Windows and doors on both sides; sufficient. Cooling by punkahs.

8. Drainage.—Surface drains; only flushed by water from bath rooms and by rain. Insufficient, as the drains are frequently filthy. Contents carried to a very short distance from barracks and hospital, and allowed to sink into the soil. A foul ditch close to the outer wall of hospital; being rectified. Refuse from privies, &c. carried away daily.

9. Water Supply.—From wells, not liable to pollution; supply abundant; water in some wells brackish, excellent in others; no analysis; raised for use by windlass and bucket. Tanks outside station, full in rains, probably producing malaria in dry weather.

10. Ablution and Bath Rooms.—Each lavatory has a tub, filled with water by a bheestie, in which men wash. Should be abolished, and basins supplied instead.

11. Intemperance.—Spirits not sold in canteen, but in bazaar; not to Europeans. Soldiers draw two drams arrack daily at station; not hurtful in moderation, but would be better to abolish it, if malt liquor could be issued. Canteen funds are insufficient "to provide amusements to keep the men from "drinking."

12. Instruction and Recreation.—Ball courts and skittle grounds; but no workshops, theatre, nor gymnasia.

Schools, library, and reading room, lighted at night; but no day room or club.

No sufficient shade. No restriction on the men exposing themselves to sun or rain.

13. Hill Stations.—Never in charge of troops on hills, but is of opinion that long hill residence predisposes men to disease on the plains, and would prefer service on the plains, with short service on the hills.

14. Hospitals.—*Site.*—Open, but imperfectly ventilated, owing to surrounding walls and outhouses. Also too close to Mount.

Water supply abundant and wholesome.

Drainage.—No sewers; only surface drains to another drain outside precincts.

Construction.—Lowest wards raised 5 feet above ground. No passage for air beneath. Materials, brick and chunam. Jalousied verandah 10 feet wide; sometimes used for sick. A surface chunam drain for carrying away roof water.

St. Thomas' Mount.

Accommodation.—Four wards of 18 beds each, two wards of four beds each; 995 to 1,178 cubic feet per bed; superficial area about 50 square feet per bed.
Ventilation.—Windows and ventilators in wall; sufficient. Cooling by punkahs and tatties.
Cleansing and limewashing once a year.
Privies in small out-houses, over cesspits. Bed stools for bad cases.
Lavatory and bath.—Out-house containing a bath; "quite sufficient."
Storage sufficient.
Bedsteads.—Wood and iron.
Cooking by pots and pans. No apparatus.
Attendance.—"Sufficient."
Sanitary state "good." No epidemic disease.
Convalescents.—No wards. Exercise in sick carts and doolies. Seats in verandahs and on top of hospital.
Female hospital.—Sick treated in military hospital; "satisfactory."

Arcot.

1. Climate.—No meteorological instruments. Climate generally a dry heat. Hot and cold weather most healthy. Immediately before and after monsoon unhealthy.

2. Diseases of Native Population.—No definite information. Epidemic cholera occasionally breaks out.

3. Diseases of Troops.—About 2·85 per cent. of admissions from hepatic disease. Usually a primary disease, and more particularly in those of intemperate habits.

During the last two years 19 per cent. of constantly sick from venereal disease. Lock hospitals and police inspection recommended.

Prevailing diseases are fevers, dysentery, cholera, and rheumatism. Typhoid fevers have lately appeared. In 1857–8, 50 per cent. of the deaths were from dysentery. In 1858–9, 84 per cent. of deaths were from cholera. In same year there were, out of 118 average strength, 343 admissions into hospital and 25 deaths. Cholera of that year arose from imperfect drainage of barracks.

4. Bazaars and Native Towns.—Drainage of bazaar sufficient. Ventilation, cleanliness, and crowding much the same as in others. Water supply "good." No latrines. Native houses good. "Dungheaps are not exposed."

5. Barrack Construction.—Eight ranges, with accommodation for 360 non-commissioned officers and men at 1,000 cubic feet and from 66 to 100 square feet per man. Serjeants' rooms give 969 cubic feet and 80 square feet per man.

Materials, brick in chunam and clay. Pantile roof.
Floors of brick, granite, and chunam; not raised above the ground.
Verandahs, in which are placed serjeants' quarters.
Wooden and iron cots.
Cleansing and limewashing whenever required.

6. Married Quarters.—A separate barrack. Rooms divided by curtains.

7. Ventilation of Barracks.—Windows on opposite sides, with ventilators above. "Sufficient." Cooling by punkahs and tatties.

8. Drainage.—No sewers. Surface drains. Sufficient for surface water, but not for cook-houses. Fluid refuse partly sinks into subsoil and is partly carried away. Cesspits for privies, about 6 feet square; cleaned daily.

9. Water Supply.—Water derived from wells; tank not used for drinking; "probably produces malaria, and is a nuisance." Wells sufficient for present supply; quantity sometimes runs short in hot season; quality, "clear, "wholesome, and without smell," but no chemical or microscopic analysis. Supply raised by leather buckets and distributed by water carriers.

10. Ablution and Bath Rooms.—No baths or lavatories. Men use tubs filled by water carriers.

11. Intemperance.—Soldiers "temperate." In 11 months, out of 229 admissions, two from delirium tremens and two from ebrietas. Each man allowed two drams a day; injurious; should be abolished, if malt liquor could be supplied.

12. Instruction and Recreation.—Skittle ground; no ball court, no gardens, no workshops, no theatre, no gymnasia, no library, but "plenty of "books, which can be read till 8 p.m., when all lights are put out."

School and day rooms.

Arcot.

No sufficient shade at barracks; "but there is at the infantry depôt barrack, "which is the hospital of the European corps when quartered at the barracks."

13. Hill Stations.—No experience, but approves of hill stations for troops.

14. Hospitals.—*Site.*—Open, freely ventilated, and healthy.

Water supply "abundant and wholesome."

Drainage.—Refuse water and impurities "removed by hand-carriage to a "distance of 30 yards from the hospital."

Construction.—Materials, brick and chunam; tiled roof; verandahs. No passage for air beneath floor.

Accommodation.—Two European wards, 34 beds each, at 1,000 cubic feet and 35 square feet per bed. Four infantry depôt wards, five beds each, at 1,000 cubic feet and 105 square feet per bed.

Ventilation by windows and ventilators in upper part of wall. Cooling by punkahs and kuskus tatties.

Cleansing and limewashing when considered necessary.

Privies 30 yards from hospital. No drainage. Cleansed by hand.

Lavatory and bath.—Sick wash in earthen bowls. No means of bathing.

Storage sufficient.

Bedding.—Painted iron or wooden cots, with tape bottoms. Usual bedding.

Cooking sufficient.

Attendance.—"Any patient can have a separate orderly on requisition of the "surgeon."

Sanitary state "good."

Convalescents.—No ward. Sick carts the only provision for exercise.

Female hospital.—None. Sick treated in quarters. "Satisfactory, as families "are so limited in number."

Vellore.

1. Climate.—No observations. Climate hot, but healthy.

2. Diseases of Native Population.—Epidemics occasionally; none for some years. Fevers occur after drying up of paddy fields.

3. Diseases of Troops.—Ephemeral, quotidian, tertian, and a few cases of quartan fever prevail. A few cases of dysentery, but no cholera this year. [This refers to native troops.]

4. Bazaars and Native Towns.—Well drained. No latrines. Cleanliness scarcely attended to. Natives perfectly indifferent to condition of their houses. Few of them without those hot-beds of disease, dungheaps and cesspits. Wind blowing over native houses and drains causes nuisance in barracks.

5. Barrack Construction.—No information as to accommodation. Materials, brick and chunam, with tiled roof. Flooring of tiles and cement, 6 inches above ground; no ventilation beneath.

6. Ventilation of Barracks.—None, except by doors and windows. No means of cooling the air.

7. Drainage.—Exceedingly defective. Attended to by local prisoners. Nightsoil carted away to a distance.

8. Water Supply.—Colourless and inodorous, but in most of the wells brackish. The harder water causes diarrhœa among new comers. Plenty of water for lavatory purposes. Water "too near the surface to require any "mechanical contrivance for raising it."

9. Ablution and Bath Rooms.—None.

10. Intemperance.—Light wines and malt liquor at cheap rates "would "be an incalculable boon to the soldier and a saving to the state." The taste for spirits, "not easily acquired by young soldiers," would die away.

11. Hill Stations.—The lower hill stations in Bengal are unhealthy at some seasons. Hill sanitaria admirably adapted for convalescents and ill-formed soldiers; but once acclimatized, inclines to the opinion that service on plains, under improved sanitary conditions as to stations, would be better than hill residence.

12. Hospitals.—Information very defective. Hospital surrounded by other buildings. Ventilation very imperfect. Floor raised 18 inches, but without air beneath. Radiation of heat from arsenal walls very great. Windows only 3 feet by 2 feet; too small for any fresh air or coolness, for which there is no other provision. Materials, brick and chunam. Narrow verandah. No winds, save eddying currents, can touch the building.

Bangalore.

1. Climate.—Climate one of the best in India. Maximum temperature 97°; minimum 55½°. Mean temperature 75°. Sun's rays powerful. From November till February cold renders woollen clothing and blankets necessary. Most favourable to health. Severe fevers rare. Cholera seldom occurs, but liver disease and dysentery are common. December to April, August, and September healthy. May to July, October to November, unhealthy.

2. Diseases of Native Population.—Intermittent (quotidian); dysentery; diarrhœa; rheumatism; hepatic disease; cholera, occasionally. Population healthy.

3. Diseases of Troops.—In 1859-60, 4 per cent. of the strength admitted to hospital with hepatic disease. Temperance, clothing, and avoidance of exposure are prophylactics.

Venereal disease constitutes half the sickness in hospital. Lock hospitals have been recently established. Benefit hoped from them, if properly conducted.

Most common malarial diseases among troops are quotidian and continued fever, acute dysentery, and rheumatism. Adjacent to the barracks is the bazaar, in which are several tanneries, a slaughter-house, and other nuisances. Disinfection of drains and latrines recommended to diminish the frequency of malarial disease.

4. Bazaars and Native Towns.—Cantonment contains 124,660 natives, located chiefly in the general bazaar, situated on sloping ground, well adapted for drainage. Open stone drains on each side main streets; smaller lanes undrained. Houses crowded together. No public necessaries. Natives resort to open spaces. Tanneries and slaughter-houses. Sanitary state "very bad "indeed." Neither sufficient ventilation nor drainage. Water supply not wholesome, "owing to the amount of filth percolating into the wells from bad "drainage." Houses crowded. Ventilation little attended to. In the better houses, where latrines exist, they are wells sunk in the ground within the precincts of the houses, which are closed up when filled, and others opened. In front of many native huts there is a dirt-heap at almost every door. Bazaars have been allowed to spring up too near the barracks, and now nothing short of removal of one or the other will remedy the evil. Filth from cowhouses flows into open drains. No arrangements for stabling bazaar horses, which, with other domestic animals, are kept in the houses.

5. Barrack Construction.—Materials, stone, brick, and mortar.

Floors of flags or chunam; some raised above ground. No passage of air beneath.

All have verandahs; never used as sleeping places.

Bedsteads of planks on wooden trestles. Iron would be better.

Whitewashing once a year inside, and once every two years outside, but oftener if necessary.

Barracks at the station for horse artillery, for foot artillery, for cavalry and for infantry. Horse artillery barracks in two ranges, containing 90 men each, at 1,000 cubic feet and 46 square feet per man. Foot artillery barracks consist of two ranges, 29 men in each, at 1,000 cubic feet and about 70 square feet per man. For cavalry eight ranges, 88 men each, at 1,000 cubic feet and 46 square feet per man. Infantry barracks are in six ranges, containing 52 to 113 men per range, at about the same cubic space and superficial area.

6. Married Quarters.—Sufficient married quarters, built or sanctioned for the cavalry and artillery barracks. Insufficient and very bad for the infantry, but the barrack is condemned, and to be given up. In this case, some married people are in barrack rooms, but not with single men.

7. Ventilation of Barracks.—All the barracks have windows and doors. In new buildings, roof and floor ventilation; generally sufficient, but defective in some old buildings.

8. Drainage.—All drainage by open surface drains to the Ulsoor tank, half a mile from most remote barrack. Sufficient for surface water. Ground favourable for drainage. No swamps or decidedly wet ground. The tank which receives the drainage is largely used for drinking purposes by the native population. All solid refuse carried away.

9. Water Supply.—Wells and tanks, but water not stored. In monsoon time, all tanks full; become smaller in dry weather. All used by natives both

Bangalore.

for drinking and bathing. Ulsoor tank, used for drinking, is the outlet for the whole drainage of the most filthy bazaar, of the cavalry, infantry, and horse artillery barracks, and of the greater proportion of station. A great nuisance in dry season. Respecting this tank, the Commander-in-Chief remarks, "The "disgustingly filthy nature of the source from which the water used at "Bangalore is taken has been brought to notice scores of times by me within "the last 4½ years, but, as usual, nothing has been done to remedy this most "crying evil." Water for Europeans is taken from wells, which are open, and "when they get dirty are cleaned." It is raised by hand or bullock labour, and carried on bullocks and water carts. To remedy these evils, it is proposed to bring a water supply 36 miles. No analysis.

11. INTEMPERANCE.—Soldiers usually "temperate;" largest number of confirmed drunkards in artillery, 5 per cent. It appears that of one-year soldiers 1 per cent. is a drunkard; after two years the proportion rises to 2 per cent., and increases with length of residence, showing the evils of bad acquired habit. In artillery, 12½ per cent. of the strength admitted annually to hospital, directly or indirectly from drinking.

In India temperance is the exception and intemperance the usual habit of European soldiers, arising mainly from their idle, listless objectless lives. "But "Government is much to blame. It places the poisoned chalice to the lips, "bids them drink freely," and when the habit is confirmed, "denounces them "as a disgrace to their country, their religion, and their humanity." "Drink- "ing to excess of ardent spirits is directly or indirectly literally the root of all "evil in the army." It causes nine-tenths of the crime, and destroys health and morals. "Unfortunately spirits are sold in canteens," "but any quantity can "be obtained in the bazaar." "It is the part of a civilized Government to devise "means to check and not to pamper this morbid appetite." "The fear of "punishment, but no moral control, checks the consumption." Probably not "three men in five go to bed perfectly sober," and when pay is issued, not two in five. The witnesses, while all admitting the greatness of the evil, differ as to the possibility of entirely prohibiting the sale. All prefer malt liquor to spirits, but any suppression should include sale in bazaars as well as in canteens. Spirits might be issued under particular circumstances. All agree as to the necessity of providing proper amusements and occupations for the men, to keep them from drink.

12. INSTRUCTION AND RECREATION.—Ball courts and skittle sheds (uncovered and useless for part of the day); no gardens; no workshops; no gymnasia.

Reading rooms and a regimental schoolmaster; also libraries; "day rooms "soldiers' clubs, workshops, theatre, gymnasia, and gardens are things unheard "of." "Regimental library has no attractions for men who read with "difficulty." "Immediately the noonday gun announces that the can- "teen is open, a rush is made for the raw spirit dram." "The canteen and "the cot divide the hours unoccupied by the daily routine of petty duties." "Alcohol and unrefreshing day sleep contribute to engender disease and "accelerate mental and physical decay.

Men allowed to leave barracks during the day. They do not expose themselves so much as formerly, but are not more healthy. They were more hardy formerly. The witnesses recommend increased means of exercise and occupation.

13. HILL STATIONS.—Hill stations such as the Neilgherries better adapted as a sanitarium than for troops. Troops on returning to the plains are more liable to liver disease, dysentery, &c. Men on going to the Neilgherries and other higher stations, are very apt to suffer from diarrhœa and febrile attacks. Best altitudes 3,000 to 6,000 feet above the sea.

14. HOSPITALS.—Four hospitals, one for each corps.

Sites of artillery hospitals good, open, and healthy; of cavalry hospital too close to latrines, sick horse lines, and tank; also partly enclosed by buildings. The infantry hospital is surrounded by high walls and the barrack, interfering with ventilation.

Water supply.—Water for horse artillery hospital obtained from Ulsoor tank which receives sewage of cantonment. "Tank just now not very clean." Water for cavalry hospital brought in puckallies from wells into which Ulsoor

Bangalore.

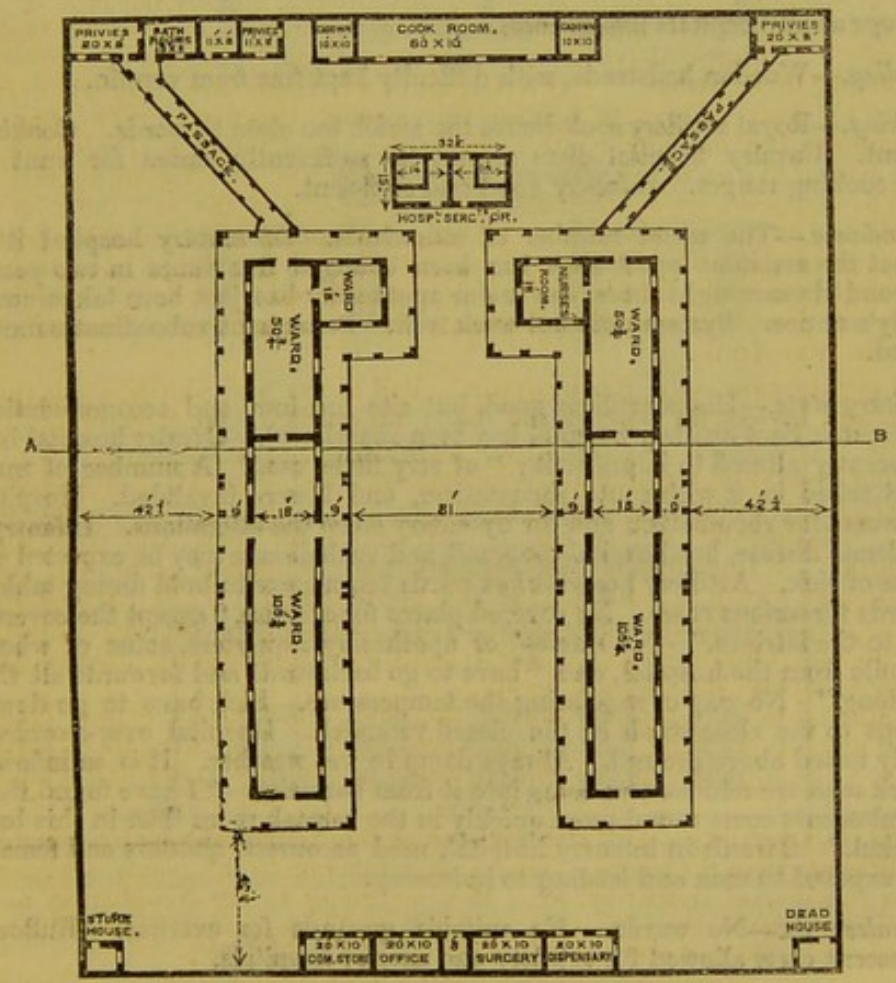
tank drains. "Water cannot be the purest." "Hundreds of bullock loads of "impure matter deposited in this tank are removed year after year, when the "tank is low, and the smell from it is most offensive." Infantry hospital supplied from same source.

Drainage.—Horse artillery hospital drained by an open ditch into Ulsoor tank, whence it derives its water. Foot artillery hospital open-drained to some low ground 340 feet distant. Cavalry and infantry hospitals have no drainage, except the cook-room of the latter.

Construction.—Horse artillery hospital of brick and chunam. Walls much too low; insufficient for sick; "has been over and over again condemned." Foot artillery hospital of brick and chunam. Cavalry, brick and mud. Verandahs: those of cavalry occasionally used for sick. All one floor. Floors solid, more or less raised above the ground. No passage of air beneath. Of cavalry hospital it is said, "one of the flags in one of the wards having sunk, "and the wards smelling disagreeably, I had it removed to ascertain the cause, "and the smell from the opening was so offensive that the apothecary and "myself were obliged to run away from it quickly." Roof water mostly sinks into subsoil.

Fig. 4 is a plan of the infantry hospital, showing its construction and arrangement, the position of administrative offices, privies, baths, &c.

FIG. 4. PLAN AND SECTION OF THE EUROPEAN INFANTRY HOSPITAL, BANGALORE.



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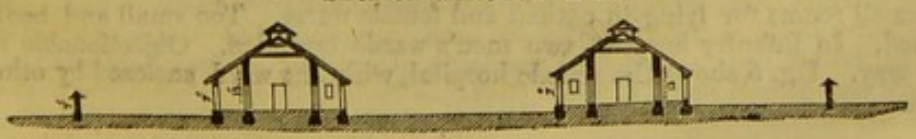


Bangalore.

Accommodation.—Horse and foot artillery, 3 wards; cavalry, 5 wards, 77 beds at 1,001 to 1,395 cubic feet and 62 to 91 square feet per bed; infantry, 6 wards, 86 beds, at 1,000 cubic feet per bed.

Ventilation.—Artillery hospitals receive benefit of prevailing winds; others do not. Ventilation by doors and windows; very imperfect, subjecting wards to disagreeable draughts and requiring doors and windows to be closed in rain. In artillery hospital, openings in roof. No means of either cooling or warming.

Cleansing.—Limewashing once a year, or oftener. Ceilings of cavalry hospital "seldom or never whitewashed."

Privies.—No drainage. Only tubs are used. Rather offensive. A cesspool attached to foot artillery hospital. "Are not more offensive than is unavoid-"able."

Lavatory and bath.—The artillery hospitals use part of verandah for lavatories. The others have separate bath rooms. The cavalry ones small and badly ventilated. Tubs are used for bathing. All water has to be carried.

Hospital linen washed by dhobies; "badly done and injured by the men "employed." At cavalry hospital two tailors constantly employed mending the linen "from this cause."

Storage at all hospitals insufficient.

Bedding.—Wooden bedsteads, with difficulty kept free from vermin.

Cooking.—Royal artillery cook-house too small, too close to wards. Cooking sufficient. Cavalry hospital diets cannot be sufficiently varied for want of proper cooking ranges. Infantry good and sufficient.

Attendance.—The usual number of attendants. Of cavalry hospital it is said that the assistant apothecary has been changed five times in two years, the second dresser eight times, the senior apothecary has just been taken away at a day's notice. System does not work well. Permanent subordinates much required.

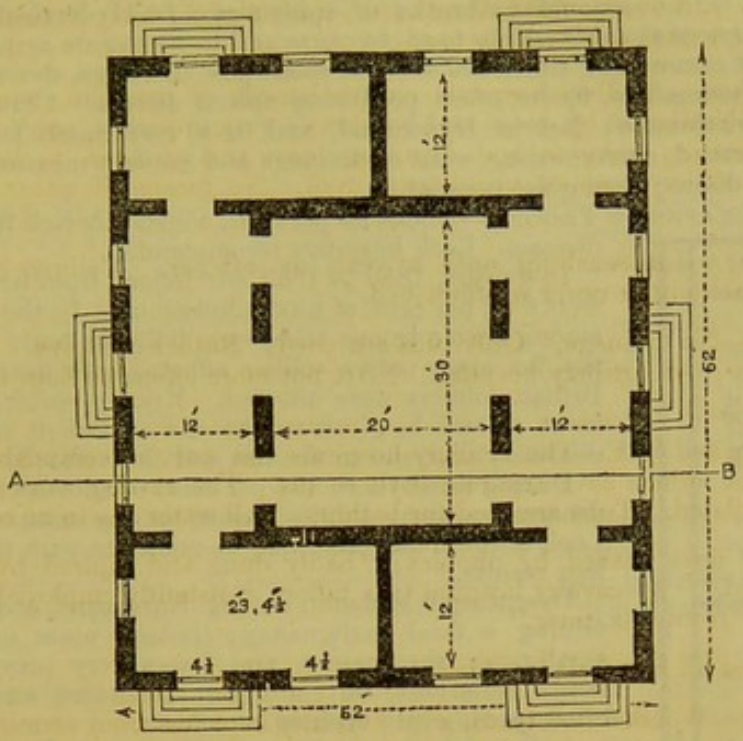
Sanitary state.—Horse artillery good, but site too low, and accommodation insufficient. Foot artillery hospital has been abandoned. Cavalry hospital has been recently altered to improve it; "of very little use." A number of men were attacked in it with acute rheumatism, and 9 were invalided. Hospital much worse for rheumatism and for dysentery since the alterations. Infantry: no epidemic disease, but hospital too small, and such disease may be expected on increase of sick. Artillery hospital has wards too narrow to hold dining tables. No wards for serious cases. No covered places for exercise, "except the covered "way to the latrines." No nurses' or apothecary's quarters, some of whom live a mile from the hospital, and "have to go backwards and forwards all the "day long." No way of regulating the temperature. Sick have to go down two steps to the close stools in the closed verandah. Hospital over-crowded. Scarcely raised above ground. Always damp in wet weather. It is so inferior that sick men are reluctant to come into it from barracks. "I have found that "convalescents come round more quickly in the barrack room than in this bad "hospital." 2 wards in infantry hospital, used as nurses' quarters and female ward: exposed to men and leading to indecency.

Convalescents.—No wards. No suitable grounds for exercise. Bullock convalescent carts allowed for artillery and cavalry hospitals.

Female hospitals.—A ward in artillery hospital. A female hospital building for cavalry, of one ward, enclosed by verandah all round; partitioned off into four small rooms for lying-in patient and female nurse. Too small and badly planned. In infantry hospital two men's wards occupied. Objectionable in every way. Fig. 5 shows the female hospital, with the ward enclosed by other rooms.

Bangalore.

FIG. 5. FEMALE WARD, BANGALORE.



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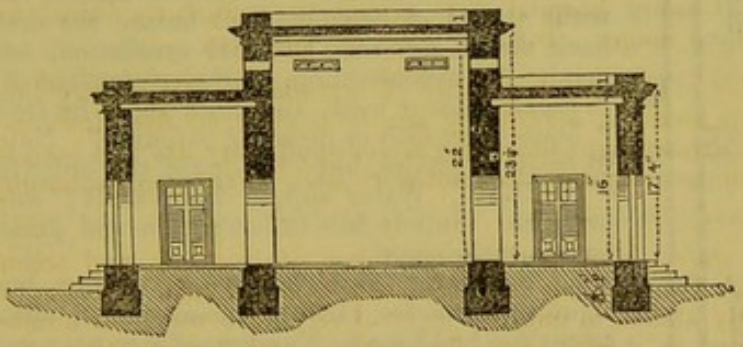
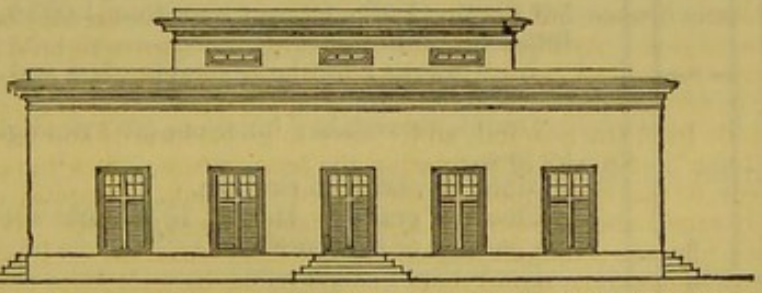


FRONT ELEVATION.



With regard to the cavalry hospital, the Commander-in-Chief remarks that, though not a first-class building, it is not altogether so objectionable as represented, and that a new one cannot be built in the present state of Indian finance.

Secunderabad.

1. CLIMATE.—Remarkably dry. Rain falls on 50 days annually. Average annual fall, 28 inches. Very changeable. Great attention required to clothing and shelter. Mean maximum temperature of year 95° in May. Mean minimum 64° in December and January. Sun temperature 113° in May. Hot winds, excessive heat and parching, with occasional dust storms, from March till June, which are however the healthiest months. July, August, September, the most unhealthy, when hepatitis, dysentery, diarrhœa, fever, continued, ephemeral, remittent and typhoid, prevail.

Secunderabad.

2. Diseases of Native Population.—Population hale and robust looking, with occasional outbreaks of epidemics. In Hyderabad there are all the influences at work which tend to cause and to propagate zymotic diseases, the most common of which are cholera, small-pox, diarrhœa, dysentery, guinea worm, rheumatism, fevers, often producing spleen disease. Climate and diet not unwholesome; but in Hyderabad, and in a very much less degree in Secunderabad, overcrowding, want of drainage and sanitary measures generally, produce disease among the population.

3. Diseases of Troops.—About 35 per cent. constantly sick from venereal disease. Lock hospitals recommended.

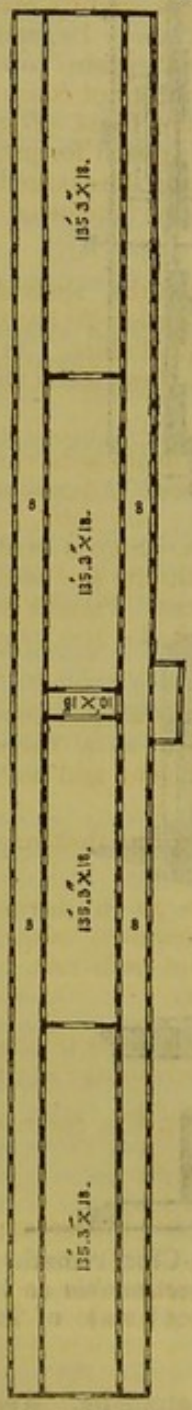


Fig. 6.—Plan of Madras Artillery Barracks, Secunderabad.

In 4 years, 1855 to 1859, admissions from hepatic disease were 6·84 per cent. of total admissions. In the same period among native troops there were 0·23 per cent. That is to say, for every native soldier affected with liver disease, 30 British soldiers were affected. Every possible discouragement should be given to the use of ardent spirits. Unnecessary exposure to the sun and chills should be avoided.

During same years, 19½ per cent. of admissions were from venereal, against 4·29 per cent. among native troops. A Lock hospital has been long in existence, with these "excellent results."

Dysentery is endemic among Europeans, occasionally attaining a fatal malignancy; cholera, more or less; also small-pox; rheumatism and fevers very prevalent, latter rarely malarious, but obscurely remittent and adynamic, often turning into typhoid.

4. Bazaars and Native Towns.—Hyderabad is a "hot-bed" of cholera. Sanitary condition very bad. All main streets of Secunderabad bazaar are drained; many back streets not so. External ventilation, on the whole, good. No overcrowding. "Superintendent of police visits "bazaar *once a week*, and fines those in front of whose "houses any filth or nuisance is found." Natives ordered to resort to privies, but "no doubt the order is extensively "evaded." Water supply from wells; some of them brackish. Supply fails in hot season and great inconvenience is experienced.

5. Barrack Construction.—One hundred and eighteen rooms for 118 non-commissioned officers, and 30 rooms for 1,843 men. Numbers of men per room vary from 4 to 10, 20, 64, 90, and in 10 rooms there are 104 men per room. Cubic feet per man from 1,003 to 1,088; square feet from 40 to 60.

No windows; but large double glass and Venetian doors on opposite sides.

Double verandahs; inner one (at Trimulgherry) occupied by men.

Materials, brick in chunam.

Floors of granite. Height, 1½ to 4 feet above the ground. No passage of air beneath.

Roofs tiled or terraced.

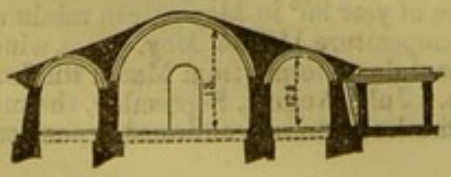
Fig. 6 shows the Madras artillery barracks at this station.

Cots, wooden. Commander-in-Chief states that, for upwards of 4 years he has attempted unsuccessfully to obtain iron cots.

6. Married Quarters.—"Sufficient."

7. Ventilation of Barracks.—"Ventilation by doors, windows, ridge ventilators, skylights, and upper wall ventilators; said to be sufficient to keep the air pure if the ventilators are kept open. Cooling by tatties.

Section.



8. Drainage.—Undergoing improvement, in old barracks, by built

drains, 4 feet by 3 feet, to an outlet 476 yards distant. Artillery barracks drained by surface drains to a soldiers' garden 140 yards distant. No drainage of any kind at Trimulgherry. Fluid refuse evaporates, or sinks into subsoil. A nullah, which intersects the cantonment, at times very unpleasant. Extent of cantonment said to be so enormous as to preclude any general surface draining. Parades and lines kept clean by regimental followers; bazaar by police. *Secunderabad.*

9. Water Supply.—Water from numerous wells; generally abundant; scanty after dry weather; in colour almost clear, sometimes slightly opaque. Analysis of five wells and one tank given, showing from above 10 grains to above 119 grains of solid matter per gallon, and from above 2½ grains to about 30 grains of organic matter per gallon. Such water apparently not considered unhealthy, although the most fatal diseases at the station are those of which bad water is known to be a predisposing cause. Water is raised for use in a skin bag, by a rope over a pulley, hauled up by bullocks, and discharged into a reservoir, whence it is conveyed by masonry conduits or skins (the usual way) to its destination.

10. Ablution and Bath Rooms.—Lavatories have tubs, shelves for basins, and grated floors; also plunge baths. There are altogether 20 lavatories and five plunge baths. Water raised by bullocks and puckallies. At two barracks water runs off by drains. At Trimulgherry, with three baths and 10 washhouses, there is no drainage.

11. Intemperance.—"Average number of confirmed drunkards varies." In one regiment 7 per cent., in another 1 in 30 of the force. Admissions to hospital caused *directly* by intemperance, 1 in less than 24; *indirectly*, 25 out of 26 (1 in $1\frac{68}{1551}$). Arrack and brandy sold in canteens. Spirits certainly injurious to health. Amount is not so injurious as the authority and sanction given to spirit drinking, and the desire it creates for more. Present indiscriminate issue "most pernicious." Sale should be abolished; beer, tea, and coffee used instead.

12. Instruction and Recreation.—Ball courts, skittle alleys; schools; splendid library and reading room, "at present occupied as a barrack." Another library and reading room, said to be very insufficient and not well lighted at night.

Three regiments have gardens. No workshops. There are theatres, and two gymnasia.

Means not sufficient for occupation; for want of it, men go out during the day, in search of liquor. Workshops for trades much required, also large recreation sheds, for exercise and games. Present shade not sufficient. Men only prohibited leaving barracks during extreme heat of day.

13. Hill Stations.—Most highly approve of hill stations for troops, but experience is still wanting as to the best manner of taking advantage of them.

14. Hospitals.—*Site.*—Three hospitals for Europeans, five for natives, scattered all over cantonment.

Water supply.—Abundant and wholesome.

Drainage.—No drains or sewers; only surface drainage. Impurities removed daily. Small cesspools at some native hospitals.

Construction.—Wards raised 1 foot to 1 foot 10 inches above ground. No ventilation beneath. Roof water sinks into subsoil, or runs away on surface. Trimulgherry hospital is upper storied. Madras artillery is abominable, and frightfully hot. It is condemned. All have front and rear verandahs.

Accommodation in European hospitals, 10 wards, 775 beds, at from 1,000 to 1,052 cubic feet and from 24 to 75 square feet per man. Two of the new wards at Trimulgherry hold each 228 sick, apparently in six rows between the windows. In this hospital 486 sick have no more than 24 square feet each. The wards are no less than 42 feet high, and out of the whole number of sick in all the hospitals, only 118 have more than 46 square feet.

Secunderabad.

A plan of one of these floors is given in Fig. 7, showing the large wards completely enclosed by other rooms, cutting off the ventilation.

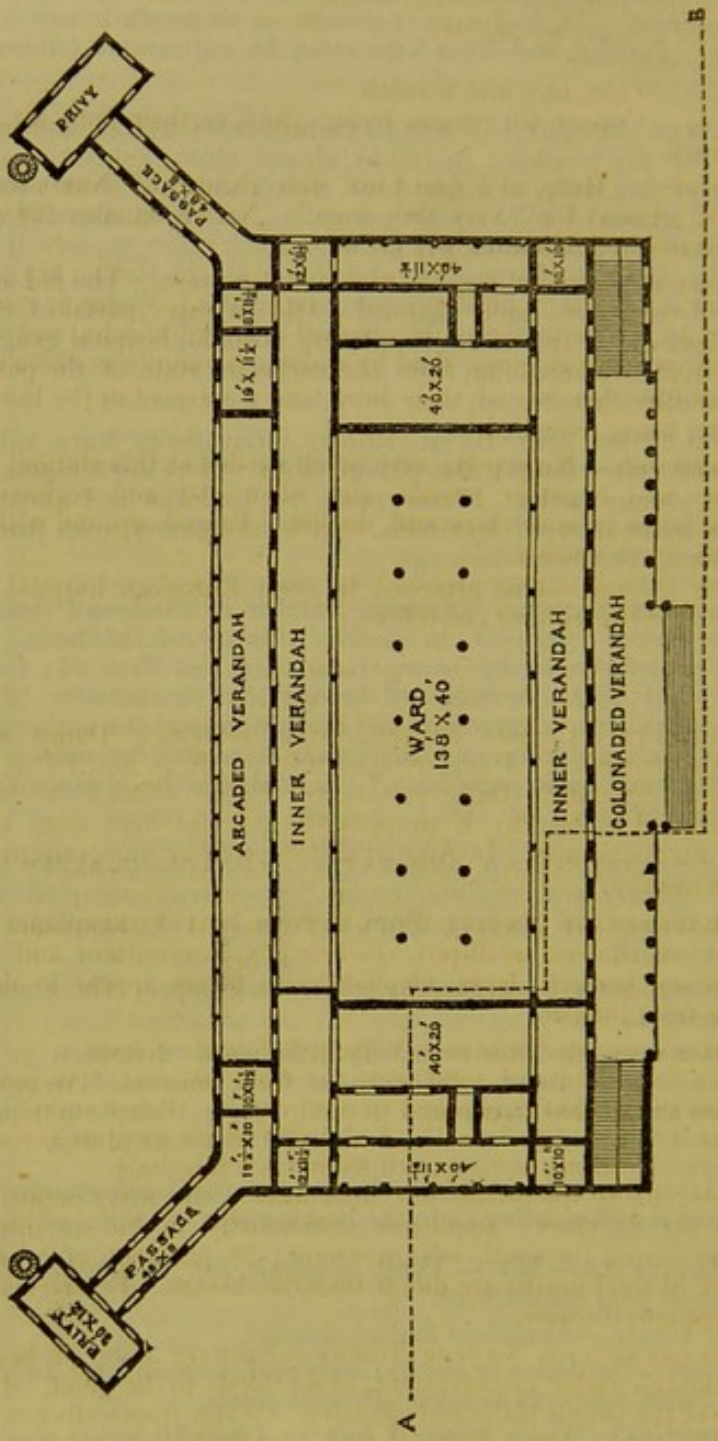


FIG. 7.—HOSPITAL AT TRIMULGHERRY.

Ventilation.—All the hospitals are exposed to prevailing winds. Ventilation only by doors and windows.

Cleansing and limewashing whenever required.

Latrines not drained. Tubs with metal linings used; removed by hand. Three of native infantry hospitals have cesspools.

Lavatory and bath.—Madras artillery hospital has a portion of front verandah cut off, not sufficient, keeps front of hospital damp and dirty. Old barrack

Secunderabad.

hospital has four bath-rooms, each with a ledge and gutters for holding basins, "sufficient for sick." At Trimulgherry, a bath-room on each floor, inadequate. Some sick have to wash in verandahs. Baths consist of nothing but bathing tubs, "amply sufficient and convenient."

Hospital washing by dhobies.

Storage sufficient.

Bedding.—Cots, iron and wooden.

Cooking.—Copper tin vessels, frying pans, earthen pots, &c., sufficient and satisfactory.

Attendance.—Hospital serjeant for each regiment. Nurse for female wards. Comrade allowed for "very sick men." Native females for women's wards. Native males in ample numbers for men.

Sanitary state generally good, with one exception. The old artillery hospital small, ill-ventilated, badly planned. Old infantry partakes of objectionable site of barracks. In one native infantry hospital, hospital gangrene frequently occurs from overcrowding, from the cachectic state of the patients, owing to the unhealthy character of their lines, and a cesspool in the hospital enclosure. The latter being remedied.

Convalescents.—No wards; very much needed at this station, especially when dysentery and hepatitis prevail, and when diet and regimen require care. Exercise taken in sick carts and doolies. Fenced ground with shaded walks and seats much needed.

Female hospital.—One attached to every European hospital. Satisfactory; but one of them requires out-offices.

Vizagapatam and Waltair.

1. Climate.—Climate healthy, rather relaxing. Damp and muggy in south-west monsoon. Usual temperature 92° F. in hot, 70° F. in cold season. Sea-breeze constant. Daily variations slight. Climate healthy. European troops should be healthy, if properly clothed and kept from liquor. Flannel should always be worn. In August and September some remittent fever; other months healthy.

2. Diseases of Native Population.—At Vizagapatam the prevailing diseases are cholera, small-pox, chicken-pox, intermittent and remittent fever, rheumatism, beriberi, lepra, elephantiasis; fevers appear to depend on wind blowing from jungles.

3. Diseases of Troops.—Very little hepatic disease.

About 6 per cent. of total sick are from venereal. At most stations dispensaries are all that is required to diminish it. Police surveillance of women in India is "most objectionable, and liable to the greatest abuse" from bribery of agents. Nothing to be gained from Lock hospitals.

Fevers, chiefly quotidian, not uncommon; dysentery occasionally fatal; no cholera for 2½ years; small-pox occasionally in hot months; rheumatism common during the south-west monsoon; 28 per cent. of admissions and 29 per cent. of total deaths are due to malarial disease. Fevers, cholera, small-pox, most frequent diseases.

4. Bazaars and Native Towns.—Sanitary state of bazaars very bad, and although under improvement, never likely to be good. Houses crowded. Habits of the people filthy and offensive. Water from wells not over-abundant; said to be good. Large heaps of filth near the fishermen's huts about the fort. Dungheaps and cesspits among native houses being removed. The "greatest "possible nuisance" at times in consequence of drying fish and from the state of the drains. Troops should be removed from this nuisance at Vizagapatam to Waltair. At Waltair, large foul ditch in the bazaar used as a necessary by natives, 500 yards from barracks.

5. Barrack Construction.—At Vizagapatam, one barrack room for 72 men, at 560 cubic feet and 43 square feet per man. Five temporary barracks at Waltair, giving about 800 cubic feet and 53 square feet per man. At Waltair, built of wattle and daub, with verandahs and thatched roof. At Vizagapatam,

Vizagapatam and Waltair.

of brick, stone, and mortar. Those at Waltair liked by the men; cool and healthy. Those at Vizagapatam hot and close, objectionable in every way, ought to be rebuilt.

No passage of air beneath floors.

Bedsteads of wood, infested with bugs to a great extent. Iron should be issued.

6. Married Quarters.—Separate houses at Vizagapatam. A building divided in separate quarters at Waltair.

7. Ventilation of Barracks.—No means of ventilation at Vizagapatam, except windows and doors; insufficient. At Waltair, ventilation insured by not carrying wall up to roof; quite sufficient. Punkahs used for cooling at Vizagapatam; not required at Waltair.

8. Drainage.—At Vizagapatam, open surface drains to sea and back-water. At Waltair, drainage runs off by surface; said to be sufficient. At Vizagapatam water lies on surface, unless cleared away. Chunam is spread over it at intervals. One or two bad drains near hospital.

9. Water Supply.—From wells and tanks, former said to be clear and good. A tank near native infantry parade ground "very foul and bad." Amount of water very limited. Water raised from wells by rope and hand. Supposed that an unlimited supply might be brought in iron pipes from a distance of five miles. No analysis.

10. Intemperance.—Temperate, with few exceptions. Three confirmed drunkards out of 77 men in European light infantry. In European veterans, 10 per cent.; 21½ per cent. of admissions to hospital from "ebrietas;" ·729 per cent. from delirium tremens. Spirits sold in canteen, and "a worse de-"scription of liquor" sold to the men within a few yards of the barracks. One dram arrack, one pint beer, or two drams arrack, may be purchased daily at canteen. Spirits most injurious to health. "The habitual daily two drams "ruin the health and habits of the soldier, who thinks that, as long as he "takes only what the Government allow him, he cannot go wrong." "The "sale should be altogether discontinued by Government." "The habit of "spirit drinking, which it establishes, is what should be avoided." Malt liquor advantageous. "But health, efficiency, and discipline would be "materially improved by tea and coffee in preference to spirits and malt "liquor;" "as has been proved when neither spirits nor malt liquor could be "procured." The only objection against this is that men partial to spirits would obtain it elsewhere. Committee propose that spirits be diluted with water, as one step to total abolition of spirit drinking.

11. Instruction and Recreation.—No ball courts. At Waltair, skittle ground, garrison and regimental library, also a school; no day room; no gardens; no workshops; no theatre; no gymnasia. At Vizagapatam, no place of recreation but canteen; no shade nor covered place for exercise; "a sad want."

12. Hill Stations.—Less loss of life on hills than plains; no objection, so far as health is concerned, to locating troops on plains, with short visits to the hills to restore health.

13. Hospitals.—*Vizagapatam.—Site.*—400 yards from barracks; houses on three sides; a marsh on fourth side, from which unpleasant effluvium arises. Upper wards used for men, lower wards for women and children; shut in, and in every way objectionable. Native infantry hospital in a low spot, nearly on a level with the swamp, badly placed; air shut out by hedges and gardens.

Waltair.—Site.—Admirable; perfectly open to sea-breeze.

Vizagapatam.—Water supply abundant for bathing, but for all other purposes water is brought from a distance.

Waltair has excellent water from well in hospital compound.

Vizagapatam.—Drainage by open drains into a marsh. At native infantry hospital and at Waltair no drainage.

Vizagapatam and Waltair.

Vizagapatam and Waltair.—Construction.—Brick and mud, tiled roofs, and verandahs. Floors raised above the ground. No ventilation beneath.

Vizagapatam.—Accommodation.—Ten wards for Europeans; 54 beds, at from 660 to 962 cubic feet and from 58 to 74 square feet per bed.

Waltair.—Accommodation.—Four men's wards; 29 beds, at about 900 cubic feet and 64 square feet per bed.

Ventilation by doors and windows only. No means of cooling.

Cleansing.—Limewashing on requisition.

Latrines.—Tubs removed twice a day.

Ablution and bath room.—Baths, tubs, and towels in a separate room; quite sufficient.

Bedding.—Wooden bedsteads, sadly infested with bugs. Iron required.

Cooking generally good. Commissariat responsible for this. In native hospitals men cook *their own* diets. When too ill to do so, an orderly friend is detailed for the purpose.

Attendance sufficient.

Sanitary state bad, both of garrison and native infantry hospitals. But there has been no hospital disease in them.

Convalescents.—No wards. Take exercise on sea beach.

Female hospital.—Wards are set apart and attended by a nurse. Confinements are attended in hospital. Satisfactory.

Bellary.

1. Climate.—Dry; not very hot. Highest mean maximum 92° F. in May; lowest 78° in January. Mean minimum from 65° in February to 77° in May. Mean monthly range of temperature 8° to 16°. No fogs. Dust storms occasionally. Climate favourable to health of troops, but less animal food and stimulating drink desirable in hot weather. Intermittents, occasional remittents, and bowel complaints occur from October to January. Ephemeral or continued fever in hot months. Rainy season healthy.

2. Diseases of Native Population.—Generally healthy. Cholera occasionally; fever at times, not malarious, at setting in of rains and during north-east wind. Ophthalmia in rains. Healthiness attributable to dry atmosphere and no superabundance of vegetation.

3. Diseases of Troops.—Hepatic disease amounted in 5 years to 3·77 per cent. of admissions. "Less spirits, or better none, would be the best "prophylactic."

Venereal disease has formed 40 per cent. of constantly sick for many years. Best remedy, marriage, a present cost but eventual saving. Lock hospitals advantageous, if efficiently worked.

Most common zymotic diseases are intermittents in cold season; sometimes remittents, not severe; ephemeral in hot weather; little dysentery; cholera about every 3 or 4 years; rheumatism frequent; bowel complaints occasion 20½ per cent. of the mortality; 24 per cent. of the admissions and 44½ per cent. of the deaths arise from malarial disease.

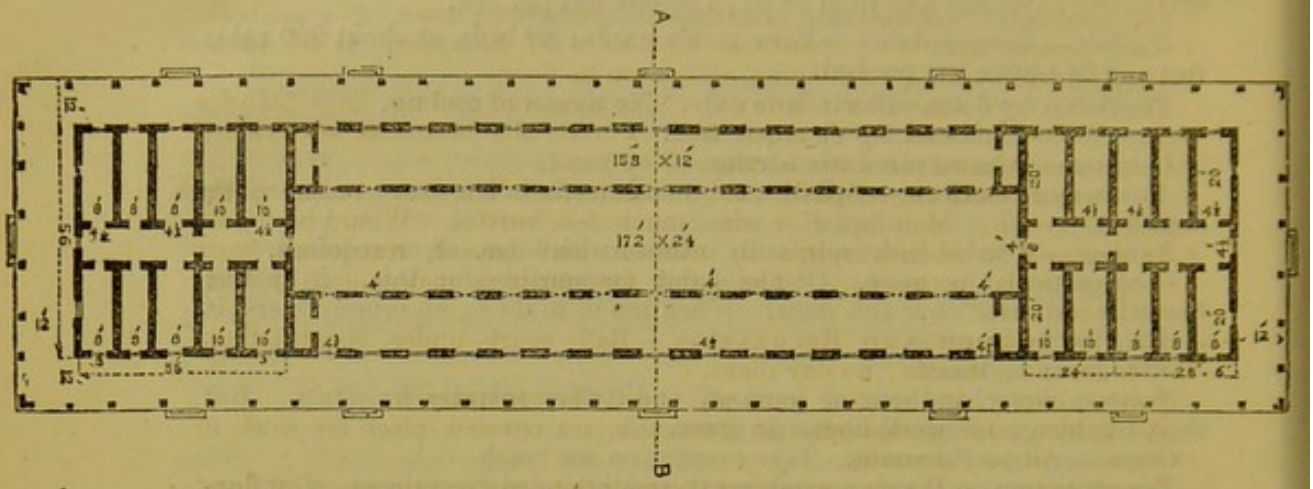
4. Bazaars and Native Towns.—"Good" drainage, and ventilation lately much improved. Water supply deficient. Cleanliness attended to. Filth removed half a mile and buried. Streets irregularly built, confined, and crowded, preventing free circulation of air. Nullahs run through bazaar, which occasionally overflow their banks and spread among the houses, many of which are mere hovels. In the better class there is generally a cesspool, "which must be injurious to health."

5. Barrack Construction.—Nine barrack ranges for men; each consisting of one centre room for 64 men and two inner verandahs for 18 men each. Cubic feet per man, 1,290 to 1,685; square feet, 64 to 105. Materials, stone. Floors of granite slabs, 2½ feet above ground, with no ventilation beneath. Construction commenced in 1843, completed in 1858.

Bellary.

Fig. 8 gives a plan and section of these barracks.

Fig. 8.—New European Barracks, Bellary.



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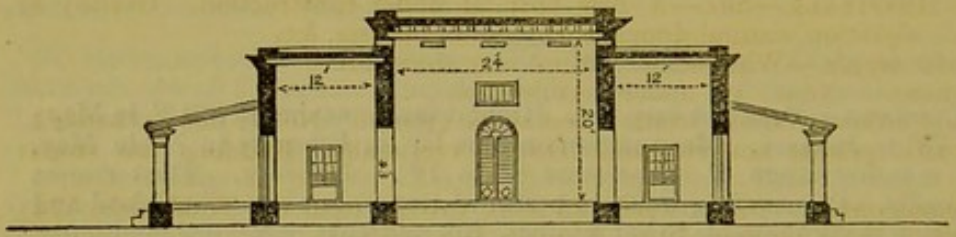
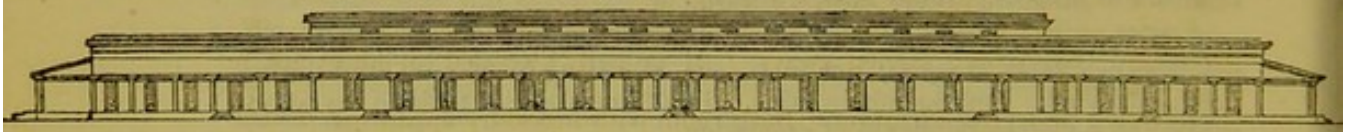


Elevation.



Beds merely planks on wooden trestles. Bugs abound in all the barracks. Iron cots required.

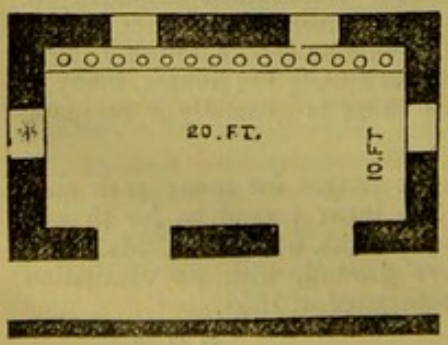
6. Married Quarters.—Ample accommodation in separate rooms.

7. Ventilation of Barracks.—No windows. Doors, half venetian, half panel. Openings for ventilation in side walls, nearly at top, having glass frames on pivots. Moveable fanlights above doors, sufficient. Punkahs used for cooling.

8. Drainage.—None, except the fall of the ground. Privies cleansed twice a day; contents thrown on the ground two miles away. Fig. 9 shows the structure of privies of this class.

Fig. 9.

Plan of one of the Privies attached to the Barracks, &c., Bellary.



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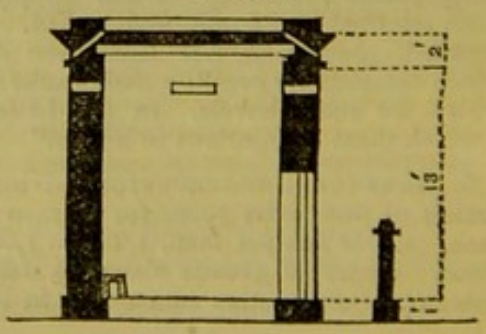


Bellary.

9. Water Supply.—Principally from wells. Two tanks; one dry for seven months, emitting unpleasant smells. Natives prohibited from bathing in one tank, but do so nevertheless. Quantity of water not known. Two wells, described as clear and pleasant, contain animalcules. Another, said to contain none, contains a considerable quantity of vegetable matter. No analysis. Present supply uncertain; sometimes fails, as it did last year. It would be better to bring water 50 or 60 miles, which can be done.

10. Ablution and Bath Rooms.—Nine lavatories and one large bath for men. Water obtained by channels from a well; the lavatories are drained into cisterns, whence the water is removed by hand.

11. Intemperance.—Spirits sold in canteens. The less consumed the better for health. Malt liquor or wine much less hurtful. Would be highly advantageous to abolish spirits in canteen and bazaar, restricting their use to particular occasions. "The habit for spirits is maintained by their "authorized use."

12. Instruction and Recreation.—Ball court under construction; skittle ground; theatre; no day room.

School, library, and reading room will shortly be constructed.

No gardens, no workshops, no gymnasia, no covered place for work or exercise. All very desirable.

No restriction on the men exposing themselves to sun or rain when off duty. More trees wanted.

14. Hospitals.—*Site.*—A new hospital under construction. Healthy as regards elevation, natural drainage, absence of malaria, &c.

Water supply.—Wholesome, but not very abundant.

Drainage.—None: yet under consideration.

Construction.—Lowest wards 3 feet above ground. No ventilation beneath. Materials, granite and chunam. Double verandahs. Building two stories high.

Accommodation.—Seven wards for men, two for women. Total beds, 174; 1,440 to 1,714 cubic feet, 72 to 86 square feet, per bed.

Ventilation by doors and windows only, said to be "sufficient." Punkahs used for cooling. Two fireplaces for warming.

Privies 45 feet from hospital. Communication by ventilated corridors. No drainage. Everything carried away. "If properly attended to, ought not to "be offensive."

Lavatory under consideration. Bath room with necessary apparatus.

Convalescents—No wards. A separate ward and separate messing very desirable.

Trichinopoly.

1. Climate.—Hot for two-thirds or three-fourths of year. Mean annual temperature 85° F. Maximum above 100°. Sun temperature 140°. Mean annual rainfall 30 inches. Whirlwinds of dust in May, June, and July. Rivers and tanks dried up. Vegetation suspended. Climate enervating, impairing digestion. Light diet required; little animal food necessary. Woollen clothing required for three months. April to July unhealthy; cholera and fever prevail. November to January healthy.

2. Diseases of Native Population.—Bowel complaints and fevers, not to excess. Native population healthy, attributable to simple and unstimulating nature of mode of living. Itch and leprosy frequent, caused by bad sanitary condition of houses and want of ablution.

3. Diseases of Troops.—Proportion of liver disease 1 to 34 of other diseases. Cause, often high temperature, but more frequently spirituous liquors. It arises from sun, drink, damp, sudden changes of temperature, sometimes from dysentery, also from scrofulous habit. Men who in England would suffer from phthisis, get abscess of the liver in India.

Proportion of venereal one-fourth or one-fifth of the total sick. In one European corps, 600 to 700 strong, half the strength was in hospital during the year from syphilis. Men when ill are away 20 days from duty. Remedy, marriage; Lock hospitals of little use, "as they frequently become instruments "of tyranny or revenge." Disease communicable long before the sufferer is aware of its existence. Lock hospitals, with stringent police regulation, might be of use.

Trichinopoly.

Troops suffer from fever, intermittent most common, cholera, small-pox. Most fertile source of disease among soldiers, bad spirituous liquor, not obtained in canteen.

4. Bazaars and Native Towns.—Drainage good. Water supply bad, scanty, and generally brackish. Bazaar usually clean, but open cesspits an intolerable nuisance when wind blows over them. Cleansing done by owners with help of Government carts. Several parts of the cantonment might be improved by pulling down walls, deserted huts, &c., filling up and levelling. Native houses very ruinous, and not ventilated.

5. Barrack Construction.—Accommodation for 148 artillery and 947 infantry. Artillery barracks consist of two centre rooms, enclosed verandah and hall. Infantry barracks consist of one tiled room, no less than 1,011 feet long, a bomb-proof 795 feet long, and five temporary barracks. Cubic space per man not given, but appears to be, from the dimensions, 530 cubic feet per man for infantry, and 816 cubic feet per man for artillery.

Materials, brick and chunam. Walls and ceilings limewashed once a year, or oftener.

Planks and trestles for beds.

6. Married Quarters.—No separate quarters. A portion of the barrack accommodation has been given over for married people.

7. Ventilation of Barracks.—Ventilation in bomb-proofs by windows and doors; in old artillery barrack by doors. Both insufficient. In other barracks, ridge ventilation, sufficient. Punkahs and tatties for cooling.

8. Drainage.—An open drain on all sides of barracks. Outlet into an open ditch, 50 yards from nearest barrack. Sufficient for surface water. Artillery barracks not drained. Refuse fluid runs down slope into fields. Old ditch of fort, 2½ miles distant, extremely foul. Eight houses in European lines are the focus of fevers and cholera. Two recent cases had to be removed from them for treatment.

9. Water Supply.—Chiefly from wells, every one of which is more or less impregnated with lime. Water partly stored in open tanks, in some of which, used for drinking in town, natives bathe. Quantity abundant; quality, clear, but most wells slightly brackish; some few sweet. Tank water neither clear nor good. Raised and distributed in the usual way. No analysis.

10. Ablution and Bath Rooms.—Four washing tubs a company; kept in verandah and filled by puckallies. Two wash-houses, drained by an open channel. Artillery barracks have no lavatory, but a plunge bath filled from a well and drained into adjoining paddy fields.

11. Intemperance.—"Usually temperate." In artillery, 6 to 8 per cent. of the men undergo confinement during the month for drunkennes. 12⅓ per cent. of admissions are directly or indirectly from intemperance. Spirits injurious to health, efficiency, and discipline; sale should be abolished in canteens, bazaars, and within a circle of 10 miles round barracks. Spirits are an irritant poison; should be abolished in toto; wine and malt liquor are better, being cordials. Tea and coffee best of all.

12. Instruction and Recreation.—Ball court and skittle ground; soldiers' garden, worked by the men. No workshops, except an armourer's; no theatre, no gymnasia.

School; garrison and regimental library; coffee rooms.

Trades should be encouraged. Many men, such as shoemakers, tailors, mechanics, &c. would go steadily to work if they had shops.

13. Hill Stations.—Approve; but service should be on the plains, with short intervals spent on the hills; 6,000 feet altitude best adapted for this latitude.

14. Hospitals.—*Sites.*—Garrison hospital a private house. European regimental hospital, 314 yards from barracks. Cavalry hospital, 66 yards from horse lines. Shengcolum hospital on open ground. Pootoor hospital close to the bazaar. All on tolerably open positions.

Water supply.—Just sufficient, and for the hospital "good."

Drainage.—"The sewage is removed in casks by scavengers to a distance."

Construction.—Floors raised from 6 inches to 3 feet 8 inches; paved with granite. Materials, brick, in mud or in chunam. Verandahs. No roof gutters. Rain water sinks into the soil, or is conveyed by a trench to the nearest road trench.

Trichinopoly.

Accommodation.—There appear to be 16 wards. Number of beds per ward not given, consequently not cubic space.

Ventilation.—No ventilators; only doors, windows, and upper fanlights. Cooling by kuskus tatties.

Cleansing and limewashing about once a year.

Privies.—Garrison hospital has none. Other three hospitals have privies without seats. All are cleansed by scavengers, and kept pure by burning salt in them. "Arrangements admit of improvement."

Ablution and bath room attached to end wards; "sufficient." Portable baths used when necessary.

Storage sufficient.

Bedding.—Bedsteads, wooden frames with tape webbing.

Cooking.—"Complete and sufficient."

Attendance.—"Sufficient."

Sanitary state.—"Very healthy." No epidemic or hospital disease.

Convalescents.—Part of a ward used. Exercise taken in doolies and sick carts. No exercising ground, except regimental parade.

Female hospital.—An old ward fitted up. "Better arrangements are in "progress."

Cannanore.

1. Climate.—A sea-coast climate. Generally equable. Occasionally chilly. In wet season moist. Productive among Europeans of loss of tone and debility after long residence. Flannel underclothing at all times necessary. Mean maximum 81° to 90° F. Mean minimum 73° to 82°. Rainfall 122 to 124 inches.

2. Diseases of Native Population.—Town of Cannanore at certain periods very unhealthy. Prevailing diseases, cholera, small-pox, dysentery, diarrhœa, attributable to overcrowding, burying dead among the houses, &c.

3. Diseases of Troops.—About 4 per cent. of cases under treatment are hepatic disease, attributed to climate.

About 33 per cent. of total sick are from venereal disease. Lock hospitals, with stringent police regulation, suggested.

Prevailing epidemic diseases are fevers of continued and remittent types, sometimes intermittent, all asthenic in form, and accompanied by other diseases. Dysentery common during south-west monsoon. Rheumatism at the same time; generally very obstinate.

4. Bazaars and Native Towns.—Bazaar not overcrowded. Drainage good. Water abundant. Cleanliness observed, but great want of latrines, leading to filth and indecency. Native houses have dungheaps and cesspits within the compounds. Cannanore itself is in a very bad sanitary state. Dead are buried within the compounds of houses.

5. Barrack Construction.—No details of accommodation.

Verandahs: inner ones used as sleeping quarters for 103 men.

Bedsteads of boards and trestles, infested with bugs. Iron ones required.

Floors of laterite stone, raised 4 feet. No passage of air beneath. Walls of laterite plastered. Walls and ceilings limewashed once a year.

6. Married Quarters.—Married people are quartered in a Christian village. Separate ranges for them are very desirable.

7. Ventilation of Barracks.—By doors, windows, penthouses in roof, and ventilators in walls; not sufficient when doors and windows are shut. Punkahs not required.

8. Drainage.—Open drains, one foot deep, one foot broad; partially paved with stone. Privies sewered to covered drains. Outlet into the sea 60 yards off. Drainage not sufficient. During wet season, all floors damp. Drains badly constructed.

9. Water Supply.—From wells; generally free from impurities; quantity ample near some parts of the cantonment; in some seasons little or none near infantry lines. Puckallies and bullocks employed for raising and distributing it; said to be "good;" no analysis.

10. Ablution and Bath Rooms.—Six lavatories. Water supplied by puckallies. Waste water runs off into barrack drains.

11. Intemperance.—"Very temperate;" only 4 admissions from drink out of 1,037. Arrack sold in canteen, but not allowed in bazaar; good malt

Cannanore.

liquor or wine decidedly preferable, but it would be injurious to suppress spirits, as men would find inferior intoxicating drinks.

12. Instruction and Recreation.—One ball court; one skittle ground; a few gardens; no workshops; no gymnasium.

School; cantonment library; theatre; but no reading room, day room, nor soldiers' club. Any extra expense incurred in increasing the means of recreation and exercise would be more than repaid by increase of health.

Men confined to barracks from 8 a.m. to 4 p.m. No shade except verandahs.

14. Hospitals.—*Site.*—On a cliff; open to sea; healthy.

Water supply.—Abundant and wholesome.

Drainage.—By surface only. Over the cliff; about 110 yards from hospital.

Construction.—Wards raised 1½ to 4 feet above ground. No passage of air beneath. Walls of laterite stone. Verandahs on all sides. One of them used for sick.

Accommodation.—14 wards, 104 beds, at 988 to 1,359 cubic feet and 62 to 97 square feet per bed.

Ventilation.—Hospital receives full benefit of prevailing winds. Doors, windows, and openings in the walls. Always sufficient, except sometimes at night. Punkahs used; not liked by men. No means of warming required.

Cleansing and limewashing once a year.

Privies.—At a distance from wards. No drainage. Tubs used. Deodorized with charcoal, and removed at night.

Lavatory and bath.—One for each ward. Tubs for lavatory. No means of bathing, except tubs.

Storage.—Sufficient, but damp in wet season.

Bedding.—Bedsteads of wood. Iron ones preferable.

Cooking.—Ample and sufficient.

Attendance.—Hospital serjeant, coolies, native servants, a nurse for sick women. Comrades allowed when necessary.

Sanitary state.—"In every respect satisfactory."

Convalescents.—One ward. A compound for exercise, but no trees or shaded walks. A hospital cart and dooly allowed.

Female hospital.—One ward in hospital. Stoppage for women, 1½*d.* a day. None for children. Satisfactory.

Ramandroog.

1. Climate.—Climate salubrious. Heat never above 84° in shade. No hot winds. Night and morning mists in June, July, and August. September and October pleasant. November and December decidedly cold. All convalescents whatever are better here from March to June than on plains; but in cold and rainy seasons, rheumatism, hepatitis, pulmonary and syphilitic disease are aggravated. Healthy from September to January. Unhealthy (so called) April to August. Fever, rheumatism, hepatic and pulmonary diseases then prevail. Mean maximum temperature, 85°; lowest mean, 64°; daily range, 4° to 9°.

2. Diseases of Native Population.—Native population said to be healthy.

3. Diseases of Troops.—Hepatic and syphilitic diseases imported. Occasional slight ephemeral fever at beginning of hot season. Other zymotic diseases are relapses.

4. Bazaars and Native Towns.—No military bazaar. Civil bazaar crowded, and not kept as clean as it might be, nor the hill generally.

5. Barrack Construction.—Built of stone. Stone floors, raised, but no passage of air beneath. Verandahs often occupied as sleeping quarters. Ten rooms. Accommodation for four non-commissioned officers and 46 men at from 1,042 to 1,155 cubic feet per man, and from 58 to 65 square feet per man.

Bedsteads wood, very bad; building swarms with bugs; iron bedsteads preferable.

6. Married Quarters.—Sufficient for the present number.

7. Ventilation of Barracks.—Ventilators near ceiling. Windows, doors, upper half venetianed; a great disadvantage in wet and windy weather. Half glass doors required. Warming by fire-places.

8. Drainage.—Natural drainage down the slope. Fluid refuse taken down the hill. Privies and urinals built on the edge of the hill, which acts as a natural drain.

Ramandroog.

9. Water Supply.—From a large tank and springs; tank used for bathing and drinking; it is supplied by the drainage of the adjacent country, and is a receptacle for everything the waters may carry down. Amount and chemical composition unknown; quality "excellent;" distributed by bullocks with leather bags.

10. Ablution and Bath Rooms.—Wash-houses built on the edge of the hill; admit of easy drainage from their position. Water supplied by puck-allies. No bath-house; want much felt.

11. Intemperance.—No intemperance here as a rule. Arrack sold in canteen. Three serjeants consume 3¾ drams a day among them; 30 privates 1¼ dram each per day. Some men take none; others draw 2 drams. Serjeants "allowed as much as they want." Never given to convalescents. Spirits in moderation not injurious to men accustomed to them; otherwise injurious; malt liquor preferable.

12. Instruction and Recreation.—Ball court; skittle ground; soldiers' garden, but no means of keeping it up; no theatre. Workshops and gymnasium very much wanted.

No library; no reading or day room.

Church, a miserable thatched mud building, very damp in monsoon, and must be injurious to health.

13. Hill Stations.—Limited experience, but considers an elevation of 4,000 feet would preserve troops efficient.

14. Hospitals.—*Site.*—Very healthy.

Water supply "abundant and wholesome."

Drainage.—None, except the hill slope, down which the bath water is emptied by natives by upsetting the tubs at a short distance from the building.

Construction.—Floors granite, 2 feet above ground. No passage of air beneath. No surface drainage. Verandahs on both sides.

No account of *accommodation.*

Ventilation by windows; ventilators near ceiling; doors with venetians, admitting damp in damp weather; stone floors become damp; bad for bowel diseases; ventilation "sufficient;" warming by fire-places.

Cleansing.—Floors once a week; walls and ceilings once a year.

Privies and urinals.—None, only night-stools; would be very offensive if there were many men in hospital; removed by natives.

Lavatory.—Two shallow earthenware pie-dishes, placed on a form in a room adjoining the ward where the night-stools are; "sufficient, but decidedly inconvenient." Two tubs in same room for bathing. Hot water carried from cook-room. After being used, tubs carried out by natives and water thrown away. In damp and cold weather the room is very chilly.

Storage.—None; only a small room at end of the building. "Insufficient by one half, and not dry."

Bedsteads.—Low cots, with tapes. Cotton quilts and blankets.

Cooking.—Done in part of barrack cook-house. Native cooks very ingenious in cooking with very meagre supply of utensils. "Sufficient."

Attendance.—"Sufficient."

Sanitary state.—"Satisfactory;" but in cold damp weather convalescents from dysentery and bowel affections liable to relapses.

Convalescents.—All the men are. Plenty of shady walks for exercise.

Female hospital.—None. Very few women and children. Treated in their own quarters; but a hospital is sanctioned.

Kamptee.

1. Climate.—Year divided into cold, hot, and rainy seasons. Cold season from October to January. Temperature 68° in house, 38° at sunrise outside. Hot season from March to June; 85° to 98° F. in house. Rainy season preceded by distressing sultriness, causing languor, restlessness, *malaise*, exhaustion. Considerable diurnal variation. Heavy dews; sometimes fogs. Maximum temperature observed, 110°. Rainy season most unhealthy. Cholera, March, April, July, August; also fevers and bowel disease.

2. Diseases of Native Population.—Fever, small-pox, cholera, stomach and bowel complaints; irregularity in diet and indulgence in bang and liquor, chief causes.

Kamptee.

3. Diseases of Troops.—In artillery, in September 1859, three cases scorbutus from insufficient vegetables. Better description of vegetables much required. Has been frequently reported.

During the last three years, one thirty-sixth of whole admissions have been from hepatic disease. *Causes.*—High temperature, exposure to sun, improper food, abuse of spirits, malaria, bad ventilation of barracks.

One-fifth of admissions in artillery from venereal disease. Lock hospitals recommended.

Prevailing diseases: fevers, of malarial origin, intermittent and remittent; dysentery, which alone causes a fifth part of the mortality; cholera, small-pox rheumatism.

4. Bazaars and Native Towns.—Principal streets have closed drains. Ventilation of bazaar imperfect. Crowding not allowed. Water derived from 220 wells; also from river. 34 latrines. A sweeper to each street, and scavengers' carts. Butchers and others provide for removing of offal. "All filth is "thrown into pits in the streets of the cantonment." "Persons committing "nuisances are closely watched and taken up daily." Poorer houses huddled together without order, on ground intersected by nullahs, making houses difficult of access. Cesspits, "where accessible," are cleansed every 48 hours. European bazaar, with 10,000 natives, is 500 yards from European infantry barrack.

5. Barrack Construction.—One barrack for 1,056 infantry in ten ranges; one for 340 artillery in three ranges. Numbers of men per room not given; nor cubic space per man. Verandahs, 10 feet wide. General construction faulty. 80 to 100 men massed under the same roof for eating and sleeping, "which is highly objectionable," "when for many months of the "year the men are confined to barracks for 20 out of 24 hours." Buildings too low.

Windows ought to be glazed.

Materials, brick and lime.

Flagged floors raised above ground; but no ventilation below.

Limewashing once a year.

Bedsteads, wood.

6. Married Quarters.—Married quarters temporary. Most objectionable in every respect.

7. Ventilation of Barracks.—Windows on opposite sides, unglazed. Three openings in roof of each barrack. "Ventilation most faulty and defi-"cient." Punkahs and tatties for cooling.

8. Drainage.—No drainage. Rain water which does not find its way through the barrack wall is left to stagnate, evaporate, or sink into the subsoil. Holes dug in the ground, and consequently a mass of mud and filth, receive the cook-house drainage, and are emptied twice a day. Privies not drained. Everything carried away. "With a native population of 70,000 souls, there "must be an immense deal of filth; but every means are taken to prevent it."

9. Water Supply.—All from wells, of which there are several hundred; quality various; mostly good, pure, and inodorous. River turbid during rains; foul and polluted with the refuse and filth of bazaar in dry season; used for cattle and for washing. No analysis. No better supply, except by damming the river.

10. Ablution and Bath Rooms.—Lavatories supplied with water from wells by carriers. Baths will be built. No proper drainage as yet; refuse water conducted by channels to openings in barrack yard wall, and thence flows away as it best can.

11. Intemperance.—A considerable number of intemperate men in artillery. Two per cent. confirmed drunkards in infantry. Two drams spirits per diem taken by five-eighths of artillery. Present manner of issue undiluted, injurious. Better to suppress sale of spirits in canteens and bazaars, and to substitute beer, tea, coffee, &c.

12. Instruction and Recreation.—One ball court for artillery; skittle alleys; gardens. No workshops; no theatre; no gymnasia; but there are theatricals in barracks.

Schools; a good library, not open at night; day rooms.

Means not sufficient. A large building proposed to contain shops, coffee rooms, game rooms, and reading room.

Kamptee.

No shade for exercise. Want of amusement makes restriction to barracks very wearisome.

13. Hill Stations.—Advisable to locate troops on the hills, with short period of service on plains; 4,000 to 7,000 feet the best elevations. Men on going to hill stations are occasionally liable to febrile attacks.

14. Hospitals.—*Sites.*—Not very good. Not free of malaria. Many small nullahs near.

Water supply.—Abundant and good.

Drainage.—None. Only surface gutters, which convey the water only outside the enclosures.

Construction.—Walls brick, tiled roofs, verandahs. Floors raised 3 or 4 feet, but no ventilation below. Roof water collected by guttering, and allowed to run into hospital enclosure.

Accommodation of artillery hospital only given. One large and one small ward. 26 beds at 1,505 cubic feet and 108 square feet per bed.

Ventilation.—Doors, windows, and ventilators in ridge; insufficient. Thermantidote for cooling.

Cleansing and limewashing every week.

Latrines.—24 yards from hospital. Not drained. No water supply; merely swept and cleansed by sweepers morning and evening. Contents deposited in pits, three-quarters of a mile distant. Arrangements offensive.

Lavatory and bath.—Under construction. None hitherto.

Storage.—None. Hospital stores kept at a distance.

Bedding.—Bedsteads of wood; tape bottoms, 18 inches from the ground, much too low. Bedding consists of quilts, blankets, pillows. "Sheets not "allowed by regulation, except in dysenteric and fever cases."

Cooking.—Cook-house opposite privy; of rudest construction. No means of roasting. Cooking wel. done, so far as means admit.

Attendance.—As usual.

Sanitary state.—Not good. Subject to malaria. Too low. Too far from barracks. Badly ventilated. Ill constructed. No surgery or reception room, except verandah. No lunatic ward. "Privy a disgrace to the 19th century." Kitchen requires re-construction. No quarter for medical attendant nearer than three-quarters of a mile.

Convalescents.—No wards. Would be a great advantage. No provision for exercise, except a rough vehicle, ill calculated for convalescents. No shaded walks or seats.

Female hospital.—None for infantry. A sick ward in male hospital used; objectionable. Artillery have a separate hospital; sufficient.

Jaulnah.

1. Climate.—No meteorological instruments nor records. Climate generally salubrious; dry and cold; liable to great and sudden variations. Fogs and damp rare; air pure; influence on health salutary. December and January most healthy. August to November unhealthy; fever, dysentery, diarrhœa, rheumatism, then prevail.

2. Diseases of Native Population.—Population healthy, attributable to salubrity of climate. Prevailing diseases, intermittent and remittent fevers.

3. Diseases of Troops.—9 to 10 per cent. of admissions from liver disease, caused by intemperance and unnecessary exposure. "Best precautionary mea- "sure, stopping sale of intoxicating liquors."

Ten per cent. of cases are venereal. Police regulation and Lock hospitals recommended.

Admissions from fever, 1 in 4 of total admissions; deaths, 1 in 15 of total deaths. From dysentery, admissions from 1 in $2\frac{1}{3}$ to 1 in $4\frac{1}{2}$; deaths, 1 in 15. From cholera, admissions 1 in 52 to 1 in 122; deaths, 1 in $7\frac{1}{2}$. Small-pox, admissions, 1 in 66; deaths, 1 in 15. Rheumatism, admissions 1 in 14. Most prevalent fevers, remittent and intermittent. Cholera sometimes epidemic. Zymotic diseases most prevalent in hot and wet seasons, with a close atmosphere. Intemperance, exposure, eating unripe fruit and vegetables, predisposing causes.

4. Bazaars and Native Towns.—Bazaar crowded; drained only on surface. Clean. Water from wells. Houses generally good, but many most wretched. No dungheaps nor cesspits, "outside at least."

Jaulnah.

5. Barrack Construction.—Materials, stone, brick, chunam. Floors raised 3 feet above ground, stone; no air passage beneath. Glazed windows. Verandahs used as sleeping quarters in very hot weather. Men take meals in back enclosed verandah. Only an artillery barrack, two ranges, for 115 men, at 1,030 cubic feet and 60 square feet per man. Infantry, 312 in number, occupy private dwelling houses.

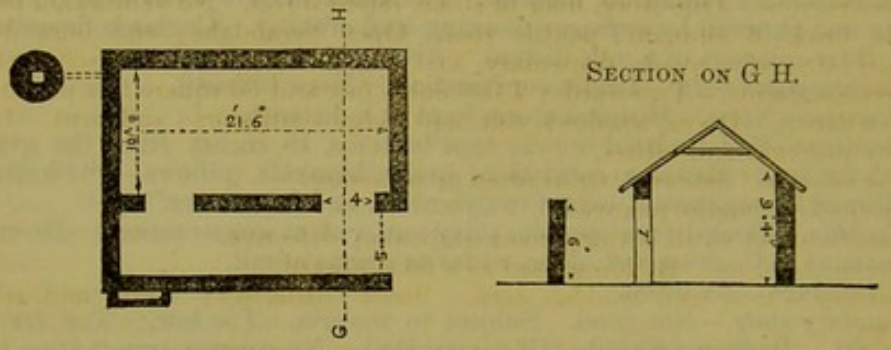
6. Married Quarters.—Not sufficient special quarters. Those who have none live in the parcherry, which is private property, consisting of most miserable hovels, badly situated, devoid of ventilation, and unfit for Europeans.

7. Ventilation of Barracks.—Doors, windows, ridge ventilators, and fanlights; good, and generally sufficient in horse artillery; in native infantry and cavalry very deficient. Punkahs and tatties for cooling.

8. Drainage.—A masonry drain surrounds barrack, receiving smaller ones from lavatories, baths, &c. Outlet on a piece of waste ground, 150 yards from barrack. Privies and urinals have cesspools fitted with tubs; removed twice a day to a distance.

Fig. 10 shows the arrangement.

Fig. 10.—Privy, with Cesspool, Jaulnah.



10. Ablution and Bath Rooms.—Two lavatories to horse artillery; deficient in size and commodiousness; supplied by puckallies with water. No plunge bath, only a bath room. [N.B.—Figs. 11 and 12 show the arrangements for cleanliness at Jaulnah and Palaveram, and by comparing the rude construction they present with the lavatory and bath plans at Wellington and Fort St. George, the difference between what ought *not* and what *ought* to be the provision for cleanliness in barracks will be self-evident.]

Fig. 11.—Lavatory and Bath Room, Jaulnah.

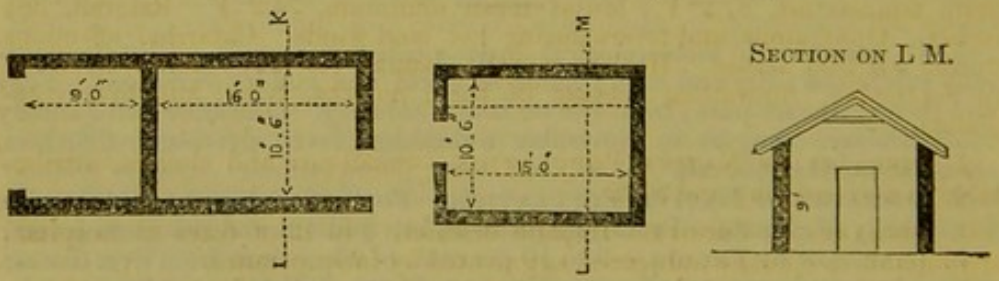
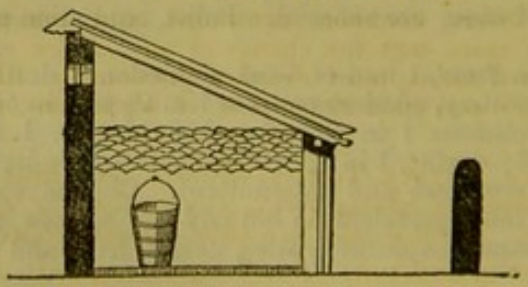


Fig. 12.—Lavatory at Palaveram.



11. Intemperance.—"Temperate" on the whole; 14 confirmed drunkards in Royal Irish detachment. Spirits sold in canteen and bazaar; two drams a

Jaulnah.

day allowed to artillery, one dram a day to Royal Irish. From 3 to 6 ozs. of arrack given as a ration to convalescents. Use of spirits, as at present, detrimental; would be decidedly advantageous to suppress spirits and substitute beer.

12. Instruction and Recreation.—Ball court; skittle ground; no gardens; no workshops; no theatre; no gymnasia.

Libraries. No schools; no day rooms. Means of instruction and recreation altogether insufficient.

No shade for exercise. Tree planting required; also a large shed for exercise and a swimming bath.

13. Hill Stations.—No experience, but consider that troops might advantageously spend the hot season on the hills. A two years' residence on first arrival would be good for troops.

14. Hospitals.—*Site.*—Unobjectionable.

Water supply.—By puckallies.

Drainage.—Impurities carried away by sweepers; surplus water drained away.

Construction.—One story, floor of stone, raised 3 feet. No ventilation below. Walls, brick in chunam; pantile roof. Open verandahs; end ones being formed into native wards, dispensary, &c. Verandahs sometimes used for sick.

Accommodation.—Two wards; 1,000 cubic feet and 60 square feet per man.

Ventilation.—Doors, windows, side and ridge ventilators; sufficient. Cooling by punkahs and tatties.

Cleansing and limewashing as often as necessary.

Privies.—Contents removed.

Lavatory.—A small bathing room and tubs; defective.

Storage.—None. Building used as a female ward.

Bedding.—Iron and wooden cots. Straw palliasses; straw and cotton pillows.

Cooking.—Done in the usual native cook-house; "sufficient."

Sanitary state.—"Good;" but more accommodation required, and hospital should be enclosed.

Convalescents.—No ward; such would be advantageous. No conveyance for exercise. No fenced ground. No shady walks or seats.

Female hospital.—None. A small building adjoining men's hospital is used.

Poonamallee.

1. Climate.—Considered healthy. Sea-breeze daily. Highest mean maximum temperature, 87·2° F.; lowest mean minimum, 74·2° F. Rainfall, 38½ inches. Ophthalmia and fevers during hot land winds. Catarrhal affections during wet cold season. Healthy months, January to May; unhealthy, June to September. Prevailing diseases of these months, bowel and liver complaints.

2. Diseases of Native Population.—Small-pox and cholera, attributable to overcrowding and filth.

3. Diseases of Troops.—Hepatic diseases, 1 in 12 of cases in hospital; attributable to climatic influences, aggravated by intemperance.

Very little venereal. Stringent police regulations and Lock hospitals desirable.

Most prevalent fevers, common, continued, and remittent. Dysentery, chiefly relapses, in cases sent for change of air. A few cases of malignant cholera have occurred among most drunken pensioners. Rheumatism, chiefly syphilitic. These diseases yield 20 per cent. of admissions, and 33 per cent. of deaths.

4. Bazaars and Native Towns.—Native huts near station dirty and unwholesome. Nuisances among them, which, when to windward, are prejudicial to barracks. There should be a strict sanitary police over natives.

5. Barrack Construction.—Two long rooms, with 300 men in each. Space per man, if given correctly, is incredibly small, 112 cubic feet and 8½ square feet per man.

Barracks pucka built.

Poonamallee.

Verandah on one side, frequently used as sleeping quarters.
Floors of large square bricks, level of ground.
Buildings every way unsuitable; have been condemned.

6. Married Quarters.—None. Married people occupy barrack rooms with single men, but separated by curtains.

7. Ventilation of Barracks.—Windows on opposite sides. Small openings in roof. By no means sufficient.

8. Drainage.—No sewerage. Drainage insufficient. East wing of barracks damp in consequence. All fluid refuse "soaks into the subsoil, where it falls." Foul ditch surrounds the fort, which encloses the hospital; has been reported over and over again, without result.

9. Water Supply.—From wells; unlimited in quantity, and "good;" contains alkaline carbonates; no analysis; raised and distributed for use "in "country earthen pots."

10. Ablution and Bath Rooms.—Two bath-houses, one for men, one for women; also tubs. Stone trough at each corner of barracks for washing. Water supplied by puckallies.

11. Intemperance.—A good deal of intemperance; sometimes necessary to try men for habitual drunkenness; 1 in 51 admissions caused directly, 1 in 124 indirectly, by intemperance. Each man allowed two drams spirit at canteen, and can obtain more in cantonment. Old soldiers all take a dram before breakfast. Malt liquor necessary to health; spirits injurious, "as they are "invariably abused by the men." Sale should be altogether suppressed.

12. Instruction and Recreation.—Ball courts and skittle grounds.
No day room; no soldiers' gardens; no workshops; no gymnasia. Occasionally temporary theatre.
Schools and garrison library open twice a week.

13. Hill Stations.—Hill stations preferable.

14. Hospitals.—*Site.*—Not good. Surrounded by fort wall, excluding air a dirty stagnant ditch, with shelving mud banks, outside.
Water supply.—Good.
Drainage.—None.
Construction.—An oblong square, floors on level of the ground, simply bricked over. No surface drainage; no guttering. Materials, brick tiled roof. Verandahs.
Accommodation.—Seven wards, 92 beds, at 480 to 600 cubic feet, and 48 to 60 square feet per bed.
Ventilation.—Imperfect. Hospital does not receive prevailing winds. Windows have no glass, only shutters, like doors. Cooling by punkahs.
Cleansing and limewashing has not been done for 12 months.
Privies.—Small pucka buildings with wooden boxes.
Lavatory.—Not at all sufficient. Hip-baths and some basins.
Storage.—Insufficient.
Bedsteads.—Wooden cots, with cotton web bottoms.
Cooking.—Kitchens much too small. No ranges. No means of roasting or baking.
Attendance.—One hospital serjeant and eight natives, or 1 to every 10 men. "Indifferent, and unsuited to European sick." "European nursing, in part "at least, would be very desirable."
Convalescents.—No wards, but their necessity apparent. Exercise in doolies and sick carts, and walking in shady walks.
Female hospital.—A portion of one of the hospital wings used. More space and accommodation necessary.

Wellington (Jackatalla).

1. Climate.—Climate excellent. Changes gradual. On first arrival battalion suffered much from low fever; not attributable to climate, but to want of drainage of barrack square. March to May unhealthy, apparently from reason mentioned. Barrack square frequently an immense swamp, 1859. Barometer from 24·307 to 24·400; mean maximum temperature, 66° F. to 75° F.; mean minimum temperature, 60° to 65°; mean temperature, 63° to 69½°.

Wellington (Jackatalla).

2. Diseases of Native Population.—Natives healthy; attributable to general abstemiousness; but those who arrive from low country suffer from intermittent and spleen disease, from sleeping on the ground. Those who sleep on charpoys not affected.

3. Diseases of Troops.—A few cases of scorbutus among men of broken-down constitution. Change to a warmer station was always had recourse to.

A few fresh cases of hepatic disease have occurred from stimulants.

Fifty-seven per cent. of total sick are from venereal. Lock hospitals recommended, and stopping pay while men are in hospital.

Remittent fever very common March till June; not so frequent since barrack was drained. Dysentery, a few cases. No cholera. Per-centages to total admissions and deaths as follow:—*Admissions:* fevers, 12 per cent.; dysentery, 2¼ per cent.; rheumatism, 4½ per cent. *Deaths:* fevers, 38 per cent.

4. Bazaars and Native Towns.—Healthy.

5. Barrack Construction.—When completed, 20 barrack rooms (16 at present), to contain 42 men per room, at 967 to 1,320 cubic feet and 64 to 66 square feet per man. 10 enclosed verandahs for mess rooms for 42 men each, at 482 to 557 cubic feet and 37 square feet per man.

Materials, brick and mortar, plastered inside and out.

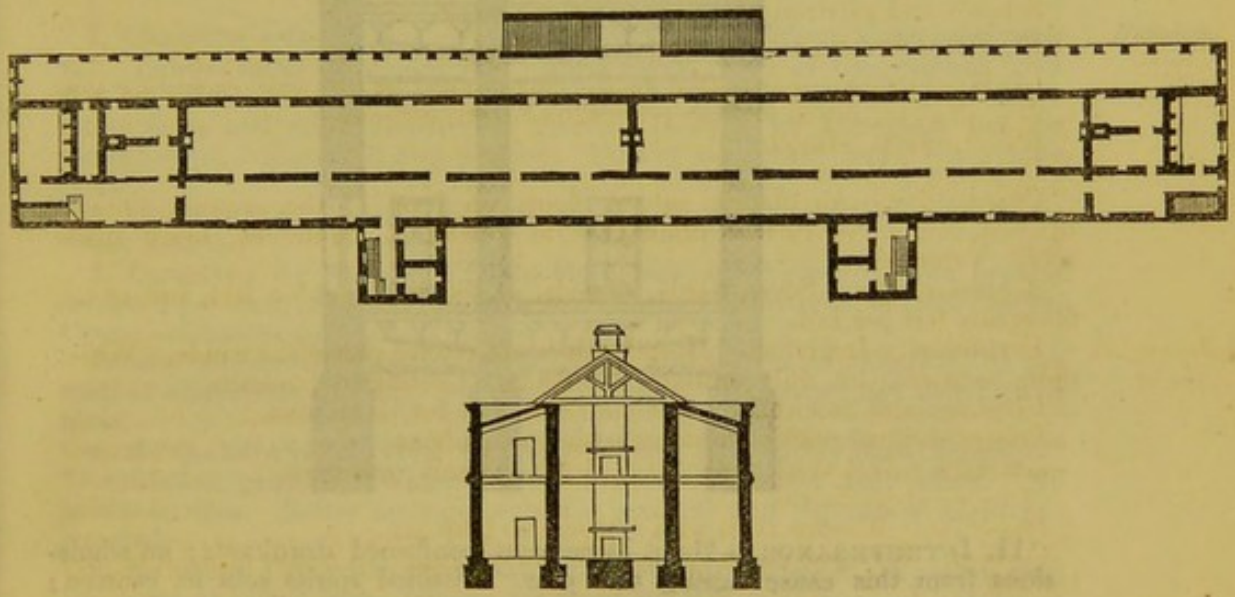
Flooring, granite, asphalte, and teak, 1 foot 6 inches above ground; free current of air beneath.

Limewashing once a year.

Bedsteads, planks and wooden trestles. Iron cots better.

Fig. 13 shows the ground-plan of the men's barracks.

Fig. 13.—Ground Plan of Barracks at Wellington.



6. Married Quarters.—Married quarters "ample."

7. Ventilation of Barracks.—Windows and doors opening to verandahs. Ventilating windows, with ventilators 6 inches square. Sufficient. Warming by fire-places.

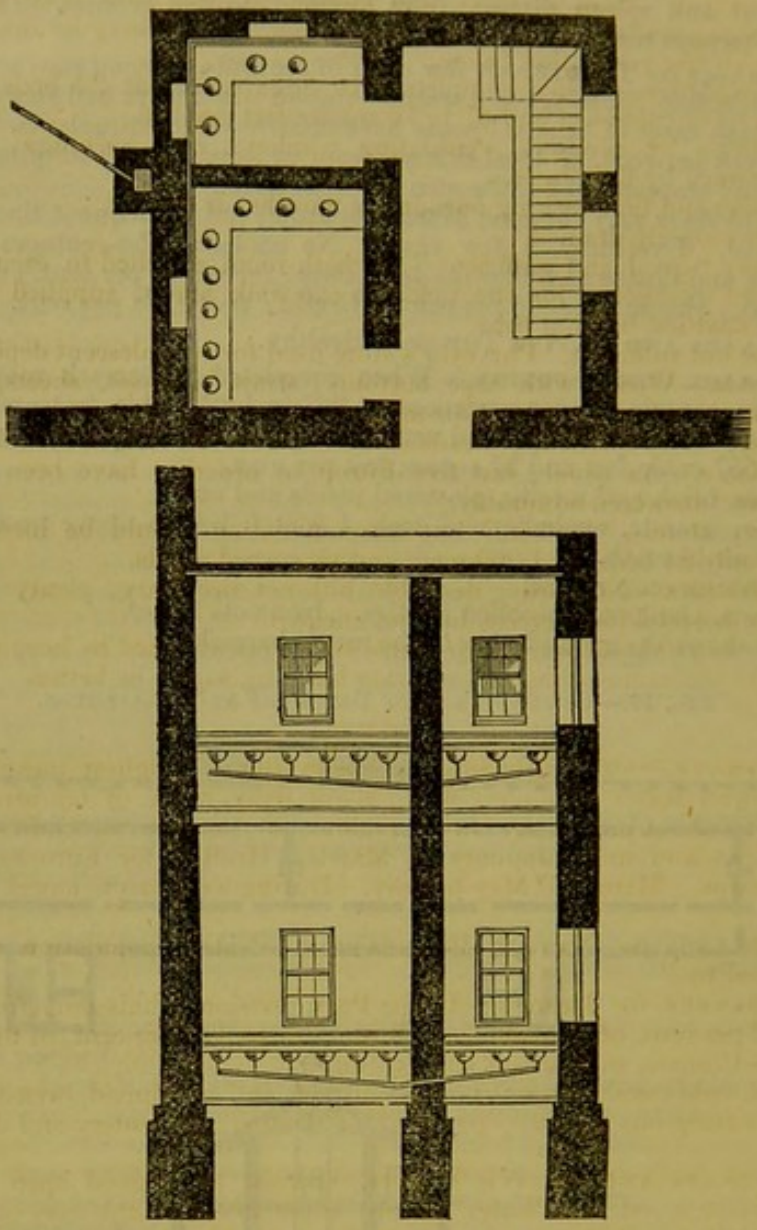
8. Drainage.—A project of pipe drainage has been submitted to Government. Drains for surface water being constructed. In the meantime, night-soil and refuse conveyed in covered carts to cesspits a mile distant.

9. Water Supply.—About 9 cubic feet a second, distributed by pipes from a reservoir with a head of 70 feet; no analysis; soft.

10. Ablution and Bath Rooms.—Plunge bath, 70 feet by 20 feet by 6 feet; water flowing continually through it. [N.B.—No information as to ablution accommodation, but the following excellent lavatory plans accompany the report. There are fixed basins, properly drained, with water laid on. The plans show the kind of arrangement required for all barracks and hospitals.]

Wellington (Jackatalla).

FIG. 14.—PLAN AND SECTION OF WASHING ROOMS WITH BASINS, WELLINGTON.



11. INTEMPERANCE.—About 1½ per cent. confirmed drunkards; no admissions from this cause during this year. Distilled spirits sold in canteen; average consumption per man daily, $\frac{8}{9}$ dram spirits, and rather less than one pint malt liquor. Spirits decidedly not conducive to health; malt liquor preferable in every respect; desirable, if practicable, to prohibit sale of spirits. At this station, where men are sent for health, canteen regulation is as follows:—Canteen open from 2 to 3 p.m.; arrack, one dram per man. Canteen open from 5.30 to 6.30 p.m.; porter or beer, one pint per man. Canteen open from 6.30 to 7.45 p.m.; arrack, one dram per man. Soldiers of battalion permitted one pint of porter or beer per man with dinner.

12. INSTRUCTION AND RECREATION.—One ball or raquette court; four skittle grounds; a soldiers' garden.

No workshops.

Theatre and gymnasia.

School, library, and reading room; one coffee room.

13. HILL STATIONS.—Strongly approve. Troops should have short periods of service on the hills and plains alternately.

14. HOSPITALS.—*Site.*—Open and healthy.

Water supply by pipes; plentiful and good.

Wellington (Jackatalla).

Drainage.—Sewage emptied into Wellington stream, 600 yards from privies. Sewers flushed several times daily.

Construction.—Built of brick and mortar. Closed and open verandahs; former occasionally used for sick; roof water carried away in drains; floors raised, with free ventilation below.

Accommodation.—When completed, 10 large wards, at 22 beds per ward; 1,145 to 1,513 cubic feet and 57 to 75 square feet per bed.

Ventilation by windows, ventilating windows, and openings; sufficient; wards warmed by fire-places.

Cleansing and limewashing once in six months, or oftener.

Privies properly drained.

Lavatory "good and sufficient." A bath-room attached to each ward. A good sized washhouse for the sick who can walk about, supplied with water troughs, chatties, bathing tubs.

Storage not sufficient. Purveyor's store used for convalescent depôt patients.

Bedsteads.—Wood, with tape bottoms; straw palliasse, sheets, blankets, pillow cases, quilted covers. Coir mattresses recommended.

Cooking.—Two kitchens; means sufficient, but iron ranges desirable.

Attendance.—As usual; but five European orderlies have been employed, which has "answered admirably."

Sanitary state.—"Perfect," but accommodation should be increased. At present, only 84 beds for 1,200 men, and no special wards.

Convalescents.—No wards; desirable, but not necessary; plenty of ground about the hospital for exercise, but not enclosed.

Female hospital.—A ward with nurse's quarters attached to hospital. Complete as to accommodation, but separate building would be better.

Rangoon.

1. Climate.—Only eight months' observations. Highest mean maximum 96°. Lowest mean minimum 63°. Mean daily range of temperature from 6°·4 to 28°·9. Climate dry from middle of October till middle of May. Heavy dews and mists January to March. Healthy for European, not for native troops. March till May healthy. During wet season bowel complaints prevail.

2. Diseases of Native Population.—Native population said to be "very healthy."

3. Diseases of Troops.—In the Pegu division, admissions from hepatic disease 2 per cent. of total admissions, and deaths 11½ per cent. of total deaths. *Causes.*—Climate, sun, ardent spirits, chills.

Fevers, ephemeral, intermittent, remittent, and continued, occasion 16½ per cent. of admissions and 9$\frac{1}{12}$ per cent. of deaths. Dysentery and diarrhœa in rains.

4. Bazaars and Native Towns.—Bazaar has "good open drainage." "Ventilation good." "Water supply abundant." Kept very clean. No public latrines. Better arrangements for removal and deposit of night-soil required.

5. Barrack Construction.—European infantry barracks, 18 rooms, each 140 × 45 × 18 feet high; 50 men per room, at 2,200 cubic feet and 120 square feet per man. Five European artillery barracks, 50 men each; same dimensions. No verandah. Roof on both sides carried 10 feet beyond outer wall.

Floors of plank and bamboo; raised from 2 to 8 feet above the ground; free ventilation underneath.

Materials, wood.

6. Married Quarters.—No special quarters. Artillery have a parcherry.

7. Ventilation of Barracks.—Doors; and windows on opposite sides. Also a narrow opening, 4 to 6 inches wide, along the top of side walls. Might be improved by having ridge ventilation all along.

8. Drainage.—Open drains for surface water. Not sufficient where the ground is low, and on which water stands till it evaporates. Barracks and hospitals damp in monsoon. Contents of privies removed to a distance in boxes daily.

9. Water Supply.—Wells and tanks. Never dry, and brimfull during rains. Quantity ample, except in hot months. Quality "most excellent."

Rangoon.

When drawn, it is of a whitish colour, but soon deposits sediment and becomes comparatively clear. Requires filtration. No analysis.

10. Ablution and Bath Rooms.—"There are lavatories, but no baths."

11. Intemperance.—Generally temperate; no confirmed drunkards; spirits sold in canteen. Average consumption per man in Madras artillery, $1\frac{3}{5}$ drams per diem. In Her Majesty's 68th Light Infantry ½ dram. Considers moderate use not injurious; immoderate, injurious to health, efficiency, and discipline. Malt liquors and wines much better. Objects, to suppression of sale of spirits, that the soldier would obtain them elsewhere. Government should afford every aid in establishing good coffee rooms, as far as possible from the canteen. All amusements should be near them. Coffee rooms to be independent of canteens.

12. Instruction and Recreation.—At this station there is a ball court; skittle grounds; schools; three libraries; day rooms; soldiers' gardens; and shops for trades; two theatres; no gymnasium. Though the means are considerable, they are not sufficient. Lofty open sheds for gymnasia are required.

13. Hill Stations.—Highly beneficial for European troops. The longer they are on the hills the better.

14. Hospitals.—*Sites.*—Artillery hospital on high ground, 100 yards from barrack. Infantry hospital on a high plateau, 180 yards from barrack. Two native infantry hospitals on low ground, one on high ground; sites open.

Water supply.—Not abundant in hot season. Filters absolutely necessary, but not generally used.

Drainage.—"Defective in every instance;" merely trenches made without reference to slope.

Construction.—Wood; thatch and shingle roofs; floors raised on posts, with free ventilation below.

Accommodation.—Infantry, two wards; artillery, one ward; cubic feet per man, 1,053 to 1,874; square feet per man, 124 to 126. In native hospitals very deficient; 360 to 455 and 826 cubic feet per bed.

Ventilation interfered with by buildings and position of hospitals. Windows and doors "considered sufficient," but roof ventilation advisable.

Cleansing.—Only one hospital has been limewashed till lately.

Privies.—Contents removed nightly, but not far enough away; thrown on the surface, vitiating the atmosphere. One has "never been cleaned out." Charcoal and lime used for disinfection, without success. Built of masonry; for native regiments, of matting, "which is most objectionable, as allowing the "escape of noxious effluvia."

Lavatory and bath differ in different hospitals. Insufficient. Bathing accommodation "totally insufficient." "Hitherto nothing but a tub of water, "without basin, soap, or towel."

Hospital linen washed by commissariat. In monsoon, aired over large baskets by means of charcoal fires.

Storage damp and insufficient.

Bedding.—Wooden cot frames; straw mattresses. Iron cots and coir should be substituted.

Cooking indifferent and not sufficiently varied. "Cooks ignorant of the art "of cooking." Utensils of a primitive kind. Cooking range required.

Attendance.—Usual establishment, with native corps; very inefficient. Comrades allowed on requisition. "Native servants, as a rule, are very inattentive, "and require great supervision, and Europeans are averse to be waited on by "them."

Sanitary state, "on the whole, good." The sick in hospital have no eating or drinking utensils but what they bring themselves from barracks (an old custom disused by regulation).

Convalescents.—Doolies for exercise, if necessary. "The convalescents "usually resort to the public gardens." No convalescent wards.

Female hospitals.—Detatched wards; satisfactory.

Tonghoo.

1. Climate.—Highest mean maximum 98° in April, rising to 105°. Lowest mean minimum 57° in January. Sometimes falls to 49°. November to end of February most healthy. May to end of August most unhealthy. Fevers and bowel complaints prevail. Climate good for a tropical one.

Tonghoo.

2. Diseases of Native Population.—Native population liable to intermittent fevers and spleen disease; said to be due to the marshy and jungly nature of the country.

3. Diseases of Troops.—Mortality during last two years about 1 per cent. of strength. Hepatic disease infrequent. Venereal rare. Cholera unknown. Prevailing diseases: fever, intermittent and remittent, and dysentery.

4. Bazaars and Native Towns.—No cantonment bazaar. Houses of native followers very bad and dangerous. Commissariat bearers too poor to build houses; "live anywhere and anyhow." "Numbers always sick, and "numbers die or have to be sent away."

5. Barrack Construction.—Twenty European infantry barracks; 50 men in each, at 2,302 cubic feet and 131 square feet per man. Four artillery barracks, 40 men in each, at 870 cubic feet and 60 square feet per man. Open verandah, 12 feet wide.

Materials, wood.

Floors raised from 3 to 7 feet above ground; free ventilation beneath.

Bedsteads most uncomfortable.

6. Married Quarters.—None, except for artillery, which are bad and not sufficiently roomy. Others sanctioned.

7. Ventilation of Barracks.—Doors; windows; a space between the roof and the top of the wall, and ventilating boards at the floor.

8. Drainage.—Drainage natural. "No sewage required." Drainage of bath houses requires improvement. Privies very bad; only a cesspit. No means of cleaning them. Charcoal and lime used for purifying them.

9. Water Supply.—From river and wells. Ample and "very good," but hard. Turbid in monsoon, and requires filtration. No analysis.

10. Ablution and Bath Rooms.—Ten wooden wash-houses for men (one per company). Water supplied by bheesties.

11. Intemperance.—"Sickness, mortality, and crime occasioned by intem-"perance" are "so trifling" that no statistical data can be given. Daily allowance per man, one quart malt and one dram arrack, or two drams arrack. Quantity of spirits drawn "conducive to health." Total abstinence "not "considered beneficial." Suppression of spirits "not recommended."

12. Instruction and Recreation.—No ball court or skittle ground. No soldiers' clubs. No workshops.

School, library, and reading room. Also a theatre.

Men grow a few vegetables. No gymnasium.

Cricket, quoits, boxing gloves, rifle matches recommended.

13. Hospitals.—*Sites.*—No European hospital. Two barracks so used; well ventilated and healthy.

Water supply abundant and wholesome.

Drainage, same as of barracks.

Construction.—Floors 7 feet above ground. Ventilation beneath.

Accommodation.—42 beds, 2,302 cubic feet and 131 square feet per bed.

Ventilation, by windows; "sufficient."

Cleansing.—Whitewashing not used.

Privies, temporary; cleansed twice a day; not good.

Lavatory and bath, temporary; tubs filled with water for bathing.

Hospital washing by dhobies.

Storage sufficient and dry.

Cooking.—A good cook-house, with range; sufficient.

Attendance according to regulation.

Sanitary state.—Good.

Convalescents.—Discharged to barracks.

Female hospitals.—None.

Cooking.

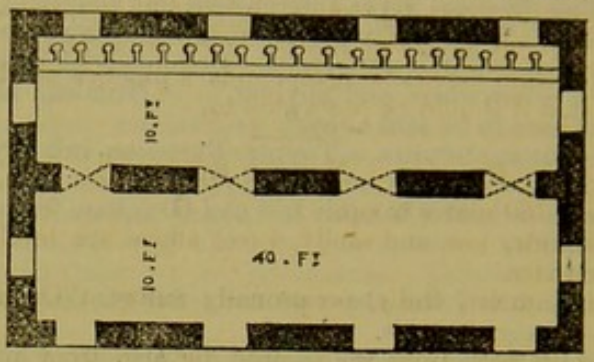
The ration in Madras Presidency consists of 1 lb. meat, 1 lb. bread, 1 lb. vegetables, 4 oz. rice, 1½ oz. coffee or ⅘ oz. tea, 2 oz. sugar, 1 oz. salt. The value is 3 annas 4 pice. The same ration is issued at all seasons and at all stations, irrespective of climate. The vegetables vary according to season. Potatoes seem to be most preferred by troops, but are not always to be had. Beef and mutton are issued at different intervals.

The usual Indian cooking apparatus is used, and the kitchens are often of a very rude character. Little complaint is made of the cooking, but notwith-

standing this, improved cooking apparatus has been successfully tried at Fort St. George. The following Fig. 15 shows a common arrangement of barrack cook-houses in Madras Presidency.

Fig. 15.

Plan of one of the Cook-rooms attached to the Barracks, Bellary.



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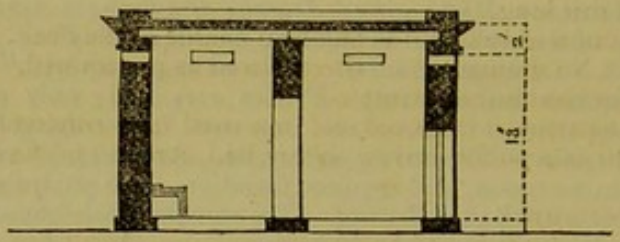


Dress. The evidence from all the stations, as regards dress, is that the changes introduced have been very important, and that the present dress is suitable as a whole. Several improvements in detail are suggested; such as improved helmets, a more uniform dye for the khakee dresses, the shades of which are so various that "no two soldiers are alike," flannel shirts, &c. But there appears to be little to complain of as regards dress at present, at least as a whole.

Duties. The duties are very much alike at the stations. Drills, parades, &c. early in the morning and in the evening. Guards at varying intervals according to the strength and the number of posts. Roll calls at various periods of the day, and occasionally at night when considered necessary for discipline. There is no evidence of men suffering in health when duties are properly carried out. Even night guards are not observed to injure health, provided the guardrooms be not overcrowded and be sufficiently ventilated. All concur in advising the thorough drilling of recruits at home, as recruit drilling in India is almost uniformly carried on at the cost of health, efficiency, and life.

Period of Service in India. The recruiting age for India should, according to the reporters, lie between 20 and 25 years. One reporter advises 3 years' home service before sending the soldier to India at the age of 25. There is a difference of opinion as to whether soldiers should be sent out direct to India, or in the first instance to an intermediate station. A majority of the reporters advocate the latter course, or sending recruits on landing to the hills. The minimum period of service in India recommended is 10 years; but the reporters generally recommend 12, 15, or even 20 years' service. One reporter considers that with improved conditions as to health, soldiers can serve as long in India as anywhere else.

Prison Cells. The prison and cell accommodation appears to be of an inferior character. At Secunderabad and Wellington prisons are being built. At nearly all the other stations the cells are described as more or less bad and unwholesome; as being too small, badly ventilated, damp or too hot, or tainted by the proximity of privies. At Kamptee the cells are away from the barracks, and there is no quarter for any one in charge. These cells are otherwise bad, and cannot be used. The prison and cell accommodation will require improvement at the same time as the stations generally.

Burial of the Dead. The burial-grounds are much in the same condition as in the other presidencies. They are generally described as being properly kept, not injurious

to health, and giving rise to no nuisance. In several instances they are overcrowded, and at times offensive, for want of sufficient area and depth of graves.

Complaint is made in one return that camp burial-grounds are not properly regulated; that interments are too near to the boundary, and that new comers are apt to be injured by the practice of their predecessors.

The dead of natives are disposed of according to caste, by burying or burning, and apparently without injury to health. One tribe, however, is accused of burying its dead within houses or compounds, a practice so directly injurious to public health that it should be put a stop to.

Principal Native Stations.

Cochin.

Accommodation, 160 native troops.

Surrounding country low and sandy, 4 feet above sea level, surrounded by the sea and back water.

Climate variable, moist, chilly, occasionally sultry. Occasions rheumatic affections.

Water derived in part from wells, unfit for use from privy infiltration. Drinking water brought daily a distance of 18 miles. One tank used by sepoys for bathing and drinking.

Sanitary condition of bazaar "as bad as it could possibly be." "Cleanliness "unknown." "No drainage." "Streets used as privies without hindrance." No regulation for cleanliness attempted.

Engineer's Department removed old rampart, and converted its site into a ditch now used as a public privy. Every odd corner "*in the most disgusting* "*condition.*"

Native houses filthy.

Most common diseases, elephantiasis arabum, small-pox, and cholera, attributable to the filthy condition and dirty habits of the civil population.

Barracks constructed of laterite in chunam, with tiled roofs. Huts of bamboo mats, with cudjan roofs. Floors 2 feet above ground. No ventilation beneath.

Diseases of native troops.—Liver, very rare; none for several years. Venereal about 1·7 per cent. of total sick. Among 160 men there were, in 1859, 20 cases of ephemeral, quotidian, and continued fevers; two cases of dysentery; two of cholera; nine of rheumatism; together constituting 26 per cent. of total admissions.

Troops temperate and cleanly in their habits.

Hospital contains five beds. Water supply good. No drainage. Have been unable to get the hospital limewashed, although applied for three times in 14 months. Hospital out of repair. "If left as it is, it would probably before "long be a ruin." Privy, a small room, with no place in which the excrement can go to be cleared away; its drainage passes through an opening in the wall, and sinks into the ground. The place often very offensive. Lavatory and bathing arrangements consist of two tubs out of repair. Attendants, one hospital orderly and a sweeper. If a sepoy is unable to cook his own food, a comrade is told off.

Vellore.

Two regiments of native infantry.

Station 675 feet above the sea. Country consists of irregular chains of hills. Part of the native lines subject to overflow of water from a nullah. Site faulty. "Selected on military and not sanitary grounds." An indigo factory close to the native lines creates nuisance. Subsoil, alluvium, overlying primitive rock. Climate "hot but healthy."

Water from wells and a tank; the former brackish, apt to cause diarrhœa in new comers. Tank water used for drinking.

The native town and bazaars extensive and densely populated. "Natives "appear perfectly indifferent to the condition of their houses, few of which "are without those hot-beds of disease, dungheaps and cesspits." Wind blowing over these causes nuisance in the barracks. Drainage from the prison a constant source of annoyance, from the filthy habits of the followers.

No latrines in the bazaar. "Cleanliness is carefully attended to." Native population suffers occasionally from epidemic outbreaks. Fevers prevail after the drying up of the paddy fields.

Diseases among the troops are ephemeral, quotidian, tertian fevers; a few cases of dysentery. No cholera this year. Most rheumatic complaints due to

Vellore.

venereal. "Epidemic influences, though not dependent on local circumstances, "are yet so controllable by sanitary measures that too much attention cannot "be paid to the observance of these."

Quilon.

Accommodation for 1,042 native troops of all ranks.

The station is close to the sea, slightly elevated above it. Surrounding country flat, sandy, and well wooded. The parade ground is sometimes overflowed with water during the rains. Full exposure to sea and land winds; the latter, however, causing rheumatism and neuralgia.

During the rains the weather is close and muggy; parching in dry weather. January to March the most unhealthy months.

Water derived from wells, 15 to 20 feet below the surface in dry weather; close to the surface in wet weather.

Barracks mostly in a ruinous condition, without doors or windows, because they are to be given up. No lavatories. No cook-houses. No privies or urinals. No drainage. Ruinous buildings interfere with the ventilation, and afford concealment for dead carcases of animals. The dead body of an old woman was found on one occasion. Native huts wretched, huddled together, without cleanliness.

Prevailing native diseases, chiefly of the skin, attributable to want of proper diet.

Among the troops hepatitis is extremely rare. There are a few cases of venereal; but the principal disease is mild intermittent fever, with a few mild cases of dysentery. There has been no cholera. Small-pox is occasionally epidemic, and rheumatism rather prevalent.

These diseases are most frequent in the hot weather. The general bazaar should be kept cleaner, and the refuse of stale fish removed more frequently.

There is so little intemperance among the native troops that no effect on disease can be shown.

The hospital is built on a mound 8 feet above the parade ground. There is one ward for 30 beds at 620 cubic feet per bed. Ventilation by openings in the walls. No water-closets or urinals. Privies cleaned regularly. No lavatory; large tubs used for bathing. Iron cots. There are no kitchens. Attendance by hospital orderlies.

Mangalore.

Accommodation for two regiments of native infantry and one-third company of artillery.

Site, quarter of a mile from the sea, and 40 feet above the level. Surrounding country undulating, wooded, hilly, dry, with wet cultivation in the valleys. Tolerably open to the sea, shut in towards the land. No information as regards climate.

Water supply derived from wells; said to be good and abundant. No analysis.

No barracks. "Hitherto surface cleansing has been performed solely by the "heavy rains falling from May to September." Authority now granted "to "entertain scavengers' carts and sweepers." No public latrines. Cantonment patrolled to prevent nuisances.

Most frequent diseases among natives, fever, with spleen enlargement.

Among the troops hepatic disease is very uncommon. Constantly sick from venereal, only one per cent. of total sick. Most common diseases, quotidian fevers and rheumatism; the latter chiefly during land winds. More cleanliness would tend to mitigate zymotic disease at the station.

Drunkenness very rare among native troops.

There are no means of instruction except schools; none of occupation or recreation whatever at any native station.

Hospital well placed; good water supply. Two wards, with space for 56 beds, at 1,100 cubic feet and 77 square feet per bed. Ventilation only by doors and windows. One privy for each ward, over a covered drain, down which lime is thrown; and it is flushed out with water every morning. No lavatories. One large tub for each ward for bathing. Hospital cots partly iron; mostly wood. No bedding. A convenient cook-room, "used for medical preparations." Attendance by a hospital havildar, detailed from the effective strength. Orderlies also detailed. "Sufficient." Convalescents are allowed to go to their own houses, parading once a day at hospital.

Hurryhur.

Accommodation for one regiment native infantry.

Station elevated 1,831 feet above the sea. Surrounding country flat; sparsely populated. Open to the prevailing winds. Surface soil, black cotton, resting on gravelly clay, with syenite and granite beneath.

Most of the well-water unwholesome from earthy salts, and too hard to be used with soap. Drinking water almost exclusively obtained from the river, ¾ mile distant. It is carried in chatties to the men by the females of their establishments, or by servants. When the river is dry, water is obtained by digging in its bed.

Climate dry, with considerable diurnal range in cold weather.

Native population subject to occasional epidemics of cholera.

Among troops hepatic disease merely accidental. Has only met with five fatal cases among natives in 20 years' service. Out of 4,400 admissions, regimental records show 51 from liver disease, with six deaths, in nine years. During the same period there were 275 admissions from venereal. The chief diseases among native troops are fevers, cholera, rheumatism, dysentery. Intermittent the most common form of fever.

Men barracked in huts. No ventilation. The streets not wide enough. No lavatories. No means of cooking. No privies or urinals. Drainage, "nil;" only open trenches, in which "the fluid refuse of the barracks flows "for a limited distance, and is chiefly disposed of by evaporation."

Bazaar much in the same state as the men's lines. Dung heaps close to the houses.

Hospital on a healthy site; well supplied with water for cleansing, but not fit for drinking. No drainage. Refuse water and other impurities flow into a cesspit with no outlet. Solid refuse removed daily. Wards have verandah. There are three wards, containing 40 beds, at 1,243 cubic feet per bed. Ventilation by doors, windows, and roof openings. Sufficient. There is a privy. No lavatory. Sick *only furnished with water*. Convalescents go home to bathe. "The process of washing, which of their own accord usually satisfies "them while in hospital, is of the most superficial and unsatisfactory nature "to the views of an European." There is a wooden tub and brick bath used remedially. Diets are prepared by the sick or their relatives. The kitchen is almost exclusively used for the preparation of poultices, &c. The attendance consists of a standing hospital havildar and orderly. Others added, if necessary. "System operates very well, and seems to be sufficient for the purpose."

Convalescents sent out with a non-commissioned officer. Native dressers attend the "followers;" medical officer admits dangerous cases into "the dis-"secting room," where the relatives attend on them.

Samulcottah.

This station contains accommodation for one regiment of native infantry.

It is situated in a valley, with about eight miles of flat land between it and the sea. The site is from 20 to 40 feet above the general level. The nearest river is about two miles distant. The station is freely exposed to the winds. But "unfortunately a large native town (with from 8,000 to 10,000 inhabitants), "with bazaars and enclosures for hundreds of cattle, &c., has been allowed to "grow up" close to it, "so that the prevailing winds carry impurity and "contamination into the chief parts of the cantonment for nine months in the "year." Close to the cantonment is a belt of prickly pear, cut into open spaces for privies. "This is a very great nuisance, of large extent, and likely "to be provocative of cholera or typhus." Irrigation from the Godavery, close to the station. It produces "no appreciable effect on health." "But the "climate is cooler in consequence."

"Samulcottah has (for the plains of India) a most healthy climate." Highest monthly mean temperature, 95° in May; lowest monthly mean, 53° in December; daily range considerable, from 8° to 25°. Rainfall about 43 inches. Out of 50 Europeans only one child has died, and this not from the climate, in three years and four months.

The water supply is chiefly from a tank fed by the rains. Water is obtained by percolation from this tank into wells, said to be "good." The tank water is used by the sepoys. One of its feeders runs through the regimental lines, and "must always bring considerable impurities with it." The water tastes of decaying vegetation. Some of the wells cannot be used, "as they contain "apparently much saltpetre and other salts." The water is raised and distributed by the ordinary leathern bucket or Palmyra leaf.

Samulcottah.

There are no barracks, merely a place of arms.
No privies or urinals.
No conveniences of any kind.
No drainage.

The most prevalent diseases among native population are small-pox, syphilis, and intermittent fever at certain seasons. Native population healthy. Country well cultivated. No marshes. Sea breezes. Population well off. Have double the pay they could secure a few years ago.

Among the native troops there has been some scorbutus, apparently caused by the use of putrid fish. Has only had one case of hepatitis, and that in an European. Prevailing diseases among sepoys: intermittent, remittent, and continued fevers; dysentery at beginning of cold weather; rheumatism frequent, severe, and obstinate; some small-pox.

There are two hospitals, garrison and regimental, under one roof; site open, well ventilated, and healthy. Water supply said to be abundant and wholesome. Hospital walls not 8 feet high, with a sloping roof. Floor on level of ground. Materials, brick. A verandah 5 feet wide on one side. There are two wards for 30 beds at from 294 to 386 cubic feet per bed.

Windows are "of wood;" when shut there is darkness and no ventilation; "should be glazed."

There is space for ventilation between wall and roof, but not sufficient for coolness.

Walls and ceilings limewashed once a month.

Privy, a small room, cleaned by totties. No lavatory. Only one tub in the pendall; exposed to the weather. No other means of bathing.

Bedsteads of iron and wood.

There is a kitchen used for boiling water, arrowroot, &c.

Natives have their food cooked and brought to them.

An assistant apothecary is the only attendant on the sick. Not sufficient.

Berhampore.

Accommodation for a regiment of native infantry.

Station 112 feet above the sea, 76 feet above the nearest lower ground.

The sea is eight miles distant, and the nearest marsh three miles distant.

Water pits and broken ground half a mile from the station, the effluvia from which are prejudicial to health.

Country highly cultivated. A little irrigation half a mile distant produces no effect on health.

The town of Berhampore half a mile from barracks. Subsoil, silicious rocks and gravel. Surface, loam.

Water from wells and tanks. Much of the tank water is unfit for drinking purposes. Well water generally not good.

Climate variable. Dry from March till the middle of June. Heat very great. September to November damp and most unhealthy from fever and beriberi. The most healthy months, February to May.

There are 820 huts, those for the privates are 11 feet 6 inches long, 9 feet broad, and 7 feet 7 inches high.

Ventilation by doors and windows; no lavatories; no cook-houses; no privies nor urinals.

No drainage. There are foul ditches in the native town, a mile distant. No means provided for surface cleansing. Refuse is deposited in front of the native houses. Bazaar said to be "drained and ventilated."

There is a good supply of water, "but it is not used for drinking." No latrines; no sanitary police; no regulations for cleanliness in the bazaar. The place is dirty and crowded. The houses poor; dung heaps before them.

The native population suffers severely from epidemics of cholera and small-pox, generally once a year. Beriberi, rheumatism, syphilis, fever.

Among the troops, hepatic disease is exceedingly rare; about 10 per cent. of the total sick are from venereal. The troops suffer constantly from quotidian and intermittent fever; also from ephemeral fever, small-pox, and chicken-pox. Epidemic cholera occurs once a year; rheumatism frequent. About a third of the admissions to hospital, and rather more than a third of the deaths, are from these miasmatic diseases. Cholera occurs all over the station; the other diseases in the places where the general sanitary conditions are bad. The use of narcotics and bad food are also predisposing conditions.

The hospital is half a mile from barracks, on a healthy site. Water supply

Berhampore.

"sufficient;" "considered good by the sepoys, but obtained from a tank used "for washing as well as for drinking." Refuse water removed by a common (surface?) "drain."

The hospital contains two wards, for 49 beds, at about 1,000 cubic feet per bed. Ventilation by doors and windows; "sufficient." Privies cleansed by sweepers. No lavatory. A bathing tub, hip-bath, and foot-tub allowed for the sick. No kitchen. Attendance, one hospital havildar, with an orderly comrade if necessary.

Mercara.

Accommodation for one regiment native infantry.

Elevation above the sea said to be 4,500 feet, and about 1,200 feet above the table land of Mysore.

Average height of barometer at 10 a.m., 26·6 inches. Thermometer 72° F.

Surrounding country hilly, partly wooded. Sea 40 to 50 miles distant.

The town of Mercara is in two parallel streets, about half a mile long. Population about 1,000. The sepoy huts are built near the fort. The ground falls in all directions.

Climate excellent. Thermometer falls to 62° F. before sunrise. During the day it is rarely 75° F. The highest observed temperature is 76° F. Rain falls for six months, and fires are needed.

Water supply unlimited. Said to be pure; but no analysis. Drawn from a well by bucket and rope.

The sepoys hut themselves, receiving only two rupees hutting money (4*s.* to build themselves a house). The huts are of mud, and with long rain and wind they often fall. The sepoys would be more healthy if they were better housed.

There is no drainage.

There are no lavatories, no latrines, no cook-houses.

Surface cleansing efficient.

Bazaar "well ventilated, drained, and kept clean."

Station and native population are healthy. Epidemics scarcely known. Prevailing diseases: fevers and bowel complaints. Hepatic disease is very rare.

Among the troops, three cases in 20 are from venereal disease.

Intermittent fever, diarrhœa, and rheumatism are the chief affections.

The hospital is 20 yards from the fort. Site freely ventilated. Water abundant and wholesome. A large cesspit has just been completed to receive the hospital drainage. "Cannot say how it will answer." Two wards; no regulation as to cubic space per bed, and no beds. Those in use appear to have been removed from a small European barrack, and are of wood, with tape supports. Floor six inches above the ground. No ventilation beneath. Materials, brick and chunam. Verandahs 10 feet wide. Windows on three sides; afford sufficient ventilation. Privy close to the hospital, in part of a building intended for a cook-room, but not used on account of the smell. No lavatory. Native sick wash in the open air, "according to their custom." Or they go to their huts for ablution. There are bathing tubs.

BOMBAY PRESIDENCY.

TOPOGRAPHY AND MORTALITY.

Returns have been received from 30 stations in this presidency. Of these 18 have accommodation for British troops; in most cases, conjointly with native troops.

Thel owest of the stations is *Bombay*, which is at the level of the sea.

The loftiest (occupied by British troops) is *Sattara*, the elevation of which is 2,320 feet above the sea.

The comparatively healthy stations, *Poona* and *Kirkee*, have an elevation of from 1,800 to 1,900 feet.

There is barrack accommodation for 2,945 men at *Baroda*, *Kurrachee*, *Hyderabad*, and *Surat*, at an elevation of less than 100 feet above the sea level.

About 1,400 men are barracked at elevations of between 100 and 1,000 feet, chiefly at *Deesa* and *Aden*.

There is accommodation for 6,722 men at elevations between 1,000 and 2,000 feet, including the large stations of *Nusseerabad*, *Mhow*, *Ahmednuggur*, *Kirkee*, and *Poona*.

At *Belgaum* and *Sattara* there are 1,500 men at elevations of above 2,000 feet, the highest, as already stated, being *Sattara*.

Dharwar, a native station on the Ghats, is the loftiest position occupied by troops in this presidency, and is 2,482 feet above the sea level.

The more important stations are situated along the line of the Ghats and west coast, at a distance of about 60 miles from the sea.

Kurrachee is on the sea shore.

Mhow and *Hyderabad* are inland, and most of the small native stations are on the sea shore.

Most of the stations are situated on ground overlying trap or other igneous rock. The surface soils are generally sandy, porous, or dry. At some stations there are black loams and black cotton soil. In a few instances there are laterite and red soils. The surface of the country is generally undulating, sometimes flat. There is not much wood or vegetation, and in most cases the surrounding country is uncultivated, and not unfrequently barren.

At two or three stations the adjacent country is overflowed during monsoon.

Stations.	Elevation above		Accommodation for British Troops.	Actual Occupation.	Mortality per 1,000 per annum British Troops.		Remarks.
	The Sea.	Surrounding Country.			Total.	Miasmatic Diseases.	
	Feet.	Feet.					
Hyderabad -	99	40	1,000	380	35·85	26·62	Undulating; sandy; dry; alluvium; calcareous hills.
Kurrachee -	27	—	1,573	1½ regt.	33·94	21·32	Dry bed of a river; sandy; blue clay over conglomerate; salt swamp of 5 square miles adjacent.
Neemuch* -	1,476	0	109	932	30·3	11·1	Undulating; rocky; red soil; trap; black soil.
Aden - -	123	123	490	521	16·17	4·28	On a volcanic crater; overlooking sea.
Baroda* - -	90	0	240	400	42·3	14·1	Flat; sandy; cultivated; swampy in monsoon.
Deesa - -	400	0	800	1,112	26·41	13·21	Flat; sandy; sloping to north; river Bunnass bounds station.
Poona - -	1,800	0	1,728	1,685	26·43	15·24	Barren; dry; undulating; Moola river ¾ mile off; trap formation.
Kirkee† - -	1,900	0	608	1 regt.	19·20	12·5	Barren; dry; undulating; river Moola ¼ a mile distant.
Nusseerabad* -	1,500	55	786	1,647	37·8	12·4	Sandy plain; large tank half a mile distant; overflows at monsoon.
Sholapore* -	1,821	0	75	75	20·9	12·5	Undulating; gravelly soil; over sandstone.
Surat* - -	33	0	132	176	51·7	11·3	Flat; swampy during monsoon; black soil on clay.
Mhow* - -	1,862	150	temp. bks.	2,100	28·4	11·5	Undulating; black soil and pebbles resting on trap.
Belgaum - -	2,200	0	984	1½ regt.	18·43	10·15	Undulating; laterite trap.
Kolapore - -	1,797	60	468				Black soil; undulating; trap rock; red earth.
Malligaum -	1,300	20	116	128			Flat and dry; black loam; trap rock.
Bombay - -	+	+	1,073	693	58·6	40·29	On sea shore; with muddy estuaries; trap with shell beaches.
Colaba - -	+	+			45·68	25·83	
Asseerghur* -	800	+	100	1 regt.	13·5		Ravines with water; trap rock.
Ahmednuggur*	1,900	+	1,200	910	27·2	10·4	Hilly; black soil overlying trap.
Kulladghee -	1,750	0					Low hills, with brushwood; river Gutpurbah close to station.
Dharwar - -	2,482	0					Undulating; mica schists; black cotton soil.
Sattara* - -	2,320	0	520	640	18·9	11·17	Hilly; black soil resting on trap.
Ahmedabad* -	320	0			20·8	10·4	Flat; cultivated; flooded in monsoon; otherwise sandy and dry.

* The mortality at these stations is taken from Inspector-General Rooke's report (Appendix to folio Report) and includes that of Queen's troops and European troops of the Indian army. The mortality at the other stations is that of Queen's infantry, given in the Statistical Tables to folio Report.

† Cavalry.

Stations for British Troops.

Bombay.

1. Climate.—*Bombay* has a sea climate, generally more or less moist, in the rainy seasons particularly so, and very debilitating, except in December, January, and February. Mean temperature highest in April, May, and June, ranging from 84° to 85°. Annual rain-fall, about 78 inches on 102 rainy days. Evaporation almost equals average rain-fall. From January to June is the most healthy period; remainder of year unhealthy.

2. Diseases of Native Population. — Small-pox; measles; cholera, epidemic and sporadic. *Causes.*—Filth, and almost entire want of circulation of air.

3. Diseases of Troops.—Prevailing diseases: ephemeral, tertian, quotidian, remittent fevers; small-pox; measles; cholera; dysentery. Fevers most frequent in August, September, and October; cholera from March till June. Sanitary condition of station very indifferent; barracks built in low damp positions; bad drainage; crowded filthy natives' dwellings close at hand; regimental lines and bazaars should be kept thoroughly clean. Barracks should be removed to higher ground. A complete system of drainage is required; sheds for shelter and workshops for the men also required. Hepatic disease frequent; venereal varies. Lock hospitals abolished generally in this Presidency.

4. Bazaars and Native Towns.—Station close to town, which contains from 400,000 to 600,000 inhabitants; native town very defective in drainage, &c.; water can be obtained from Vehar waterworks; municipal commission, consisting of deputy commissioner of police, officer of Bombay engineers, and an European inhabitant; the first and last elected by bench of magistrates; engineer appointed by Government superintends the sanitary police; native houses generally in a filthy condition; much ordure in precincts of buildings, where it has been accumulating for years; nuisance is experienced in town barracks and Fort George by wind blowing over native houses; butchers' shambles and public necessaries half a mile distant; site of slaughter-house as bad as can well be, close to a proverbially unhealthy native town; sea breeze cut off by bazaars, large buildings, &c.; washermen's tanks particularly obnoxious.

5. Barrack Construction.—Three barracks, viz.:—

Town.—Five rooms (on two floors), two of 71 men each, at 1,518 cubic feet and 132 square feet per man; three of 106 men each, at 1,415 cubic feet and from 107 to 126 square feet per man. Buildings, three sides of a square. Plan and arrangements very bad; privies, bath rooms, ablution rooms, cook-house, in close proximity to men's rooms, some under their verandahs; arched doorways on inner side on ground floors; iron bars with wooden shutters in outer walls; venetian shutters on upper floors; ground floor of stone flags, one foot above ground; no passage for air beneath.

Fort George.—Six rooms (on two floors; no windows, only doors) of 44 men each, at from 900 to 1,148 cubic feet and from 77 to 80 square feet per man. Verandahs, 11½ feet wide; ground floor, flags, 4 feet above ground; no passage for air beneath.

Colaba.—Six rooms of 53 men each, at 1,075 cubic feet and 89 square feet per man. Long narrow rooms, with verandahs; windows and doors on opposite sides; glazed shutters on the west, plank shutters on the east side; three barracks have mud floors; three have stone floors, 1½ feet above ground; no passage for air beneath. *Depôt Barrack* at Colaba.—One centre room, completely enclosed by other rooms, without any direct communication with external air. Floors of all barrack rooms should be raised 14 feet above ground.

6. Married Quarters.—No separate quarters in town barracks; lower story generally used. In Fort George, sufficient in the front and rear verandahs. At Colaba and depôt barracks, sufficient.

7. Ventilation of Barracks.—Town barracks ventilated by iron cowls on ridges; Fort George barracks by wooden cowls; also by openings high up in walls. Colaba barracks have lofty continuous ventilators with glazed shutters. Depôt barracks have cowls. Ventilation generally sufficient; "at "least there are no complaints." Improvement imperative. Air cooled by punkahs.

Bombay.

8. Drainage.—Town barracks drained by sewers 250 feet long (to sea), 1½ feet broad, 5 to 12 feet in depth. At Fort George, latrines not drained except into open ditch, always in a foul state. Main drain of Colaba barracks 2 feet square, flat bottom. Great nuisance. At Byculla stench at times *unendurable*. Drainage of native town very defective.

9. Water Supply.—Water, derived mostly from wells, contains for the most part a large quantity of lime and brackish sea salt in addition. (No detailed analysis.) Said not to be unwholesome; raised by ropes and buckets and Persian wheels, and distributed by water carts, puckallies, and bheesties. Vehar lake water, which has been conveyed to Bombay, could be laid on.

10. Ablution and Bath Rooms.—Town barracks; lavatory has stone floors, and water supplied by bheesties. So also at Fort George and Colaba. It is put into barrels; drained away after use.

11. Intemperance.—One per cent. confirmed drunkards; 3·7 admissions to hospital (per cent.) from intemperance; spirits sold in canteen and bazaar; one dram per diem allowed as a ration, injurious to health and efficiency; should be abolished as ration, and sale suppressed at canteen and bazaar; malt liquor better; but tea, coffee, lemonade, best; penalties for selling liquor to soldiers outside; but law almost inoperative.

12. Instruction and Recreation.—No means of instruction or recreation at town barracks; at other barracks, ball courts; skittle grounds; schools; library and reading room; two barracks have no library; no workshops; theatre occasionally; cricket; men restricted to barracks till 5 p.m.; regimental savings banks advantageous; no shade for exercise except verandahs.

13. Hill Stations.—Hill stations do well for healthy men, and for those simply debilitated from fevers, but are injurious for dysentery and structural disease. They are not beneficial throughout the year. Their peculiar diseases are, head affections, rheumatism, diarrhœa, and dysentery. Elevations above 4,000 feet are not suited to chest affections. Service in the plains, with shorter period of change to hills, might be expected to be the most advantageous to health.

14. Hospitals.—*Sites.*—Generally good, except at Colaba, where the hospital is on low ground.

Water supply.—Excellent, from the Vehar waterworks.

Drainage.—Fort George, open drains into ditch, covered drains into cesspools; Colaba, open and covered drains to sea; depôt hospital, cesspools emptied when required; also into sea.

Construction.—Fort George lower ward, raised 6 feet above ground, free ventilation beneath; Colaba and depôt hospital raised 2 feet; no ventilation beneath; roof water at Fort George falls on ground; at Colaba it is collected in tank; materials, lime and stone masonry; closed verandah, only used for sick on extraordinary occasions.

Accommodation.—Fort George, 8 wards, 3 to 15 beds, 1,788 to 2,223 cubic feet, 154 to 173 square feet per bed; 58 beds in all. Colaba, 56 beds in 8 wards of 6 and 8 beds; 1,953 to 2,082 cubic feet, 156 to 166 square feet per bed; depôt hospital, 80 beds in 4 wards of 20 each, 2,079 cubic feet, 126 square feet per bed.

Ventilation.—Fort George, doors, windows, windows in roof, and punkahs. Colaba, roof ventilators, doors, windows, punkahs; depôt hospital, the same; ventilation "sufficient;" charcoal burners used for warming in damp chilly weather.

Cleansing.—Limewashing every three months.

Privies.—Fort George, contents emptied twice a day into sea behind barracks. Colaba, the same; depôt hospital, cesspits emptied daily; waterclosets said to exist at all the hospitals from 10 to 30 feet from wards.

Ablution and bath room.—Fort George, four bathing places, "where the patients "can bathe themselves from water barrels;" "sufficient." Colaba, one lavatory; patients "take water to bathe themselves from wooden trough lined "with zinc;" depôt hospital, two lavatories, water supplied in barrels or tubs; "sick pour the water over themselves with a tin pot."

Storage.—Sufficient and dry.

Bedding.—Iron cots.

Bombay.

Cooking.—Appliances sufficient; diets should be more varied; "mutton "might be allowed twice a week as a change."

Attendance.—Hospital serjeant; a nurse or native boy for each bedridden patient.

Sanitary state.—Generally good; no epidemic disease.

Convalescents.—No special provision for exercise; no wards; allowing convalescents in barracks "does not answer well;" better kept in hospital till fit for duty.

Female hospital.—Arrangements quite equal to those for the men; European female nurse or matron allowed; satisfactory.

Poona and Kirkee.

1. Climate.—At Poona and Kirkee the climate is very favourable to health. The mean temperature of the hottest months, April, May, and June, varies from 83° to 88°; but the mean maximum temperature is nearly 95° F. in April. Rain-fall moderate. There is almost total freedom from fogs; dampness in a mild degree only observable during rains. Great sensible variation of temperature between day and night. The unhealthy months are October, November, March, April, May and June.

2. Diseases of Native Population.—Fevers, intermittent and remittent, prevailing at beginning and end of rainy season; spleen disease rare; bowel complaints; eruptive fevers; small-pox; chicken-pox; measles prevailing in hot season; catarrh and rheumatism in cold season. Population generally healthy, from elevation, trap sub-soil, freedom from alluvial deposits, sea breezes, good water.

3. Diseases of Troops.—The most frequent diseases at these stations are, fevers, ephemeral and intermittent. Remittents are less prevalent. At Kirkee the tertian type is the prevailing one; dysentery, diarrhœa, cholera, rheumatism, syphilis, eruptive fevers also prevail, the latter chiefly at Poona. Acute dysentery is the result of chills, sometimes of intemperance. At the time these diseases prevail the atmosphere is generally close, muggy, and loaded with electricity. Hepatic disease also occurs, the result of climate and intemperance. Flannel next the skin, moderate exercise, and a limited use of intoxicating drinks are required. Hepatitis is almost entirely absent from the native army, on account of their abstinence from spirituous liquors and their simple diet. Fourteen per cent. of total sick in hospital are venereal. Lock hospitals recommended.

4. Bazaars and Native Towns.—*Kirkee.*—Drainage of bazaar less objectionable than in most; no crowding; "little fault" in ventilation; water sufficient, from river; bazaar clean; latrines needed for bazaar people; "chowdrie" inspects bazaar daily, "conductor" four times a month; dust carted to jungle; native houses of average construction; no dung-heaps or cess-pits; no nuisance.

Poona.—Bazaar not well drained, nor can it be without more water; ventilation pretty good; crowding; water insufficient; bazaar tolerably clean; no latrines; "poorer classes have to go to a distance;" one havildar, one naique, and 20 peons superintend cleansing; filth and rubbish removed daily; establishment far too small for a population of 27,000; vegetation kept under, and drains cleaned; houses generally good, or being improved; no dung-heaps; no regularity of streets or houses; bazaar close to officers' quarters; nuisance in barracks from villages of Ghorepoore and Wanowrie; cholera occurred first in Wanowrie, 100 yards from officers' lines; village of Kirkee (so near that it is a nuisance) "should be removed;" city of Poona in a hole (population 80,000) three-quarters of a mile to windward of station of Poona.

5. Barrack Construction.—*Kirkee.*—Sixteen barracks containing 36 men each, with from 1,034 to 1,487 cubic feet and 64 square feet per man. Open verandah to each barrack, 5 feet to 9 feet wide; never used as sleeping quarters, except on emergency. No glass windows, only wooden shutters; materials of new barracks, burnt brick and lime; of others, burnt brick and mud; floors of the former paved; floors of the latter, mud; floors of old barracks not raised above ground; new barracks raised 3 feet, but no passage of air beneath. Floors should be raised 14 feet above the ground.

Poona and Kirkee.

Poona.—Thirty-two barrack-rooms containing 40, 42, 84, and 96 men per room, at from 902 to 1,314 cubic feet and from 57 to 76 square feet per man. Some barrack rooms have closed verandahs; windows and doors on opposite sides. Closed verandahs sometimes used as sleeping quarters; materials brick and lime plastered; some floors are paved and raised 3 feet above ground; on passage of air beneath. Some of the barracks have upper stories.

6. Married Quarters.—*Kirkee.*—"Sufficient, but extremely bad in con- "struction, except part of superior non-commissioned officers' quarters."
Poona.—"Sufficient."

7. Ventilation of Barracks.—*Kirkee.*—In old barracks, including all except two, there can scarcely be said to be *any* ventilation. Pigeon-holes in roof, but during rains, when ventilation most needed, they have to be covered with tarpauling. New barracks ventilated by louvre boards on sides; holes of insufficient size in upper part of walls; louvres in roof; arrangements on the whole good. Ventilation not sufficient to keep air pure by night; huts and guard-rooms have no ventilation whatever, except doors and windows; no means of cooling air.

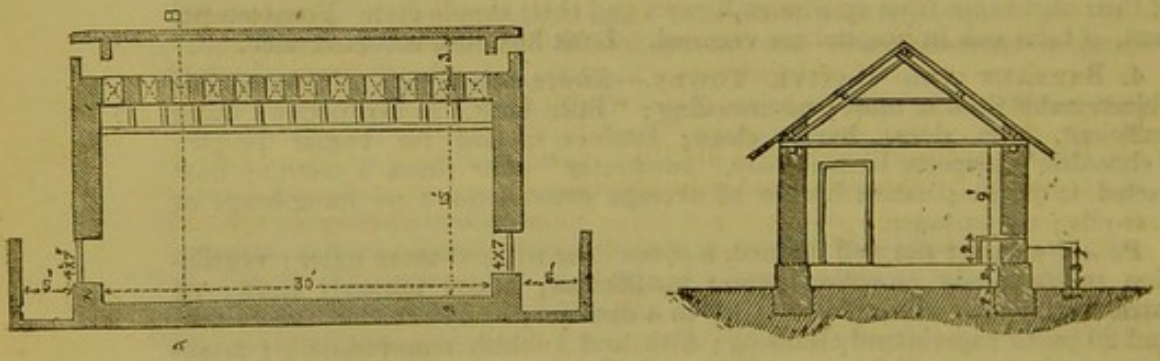
Poona.—Ventilation by doors and windows. Ensures "some degree of ven- "tilation." Wanowrie barracks, upper story ventilated along ridge; other barracks have cowls, objectionable from leakage during rains; weather side has to be "dammed up" during monsoon. Ventilation in all barrack rooms insufficient; guard rooms ventilated by doors and windows. Arrangements independent of these required both at Kirkee and Poona.

8. Drainage.—*Kirkee.*—No arrangements for draining barracks or for carrying away refuse water from wash-houses, cook-houses, privies, &c.; all waste water, filth, &c., removed to a specified locality by sweepers. In two new barracks, two small cesspits at end of each building; emptied daily; in other barracks, refuse water runs into tubs. Barracks and hospitals wet and damp during three rainy months.

Poona.—No drainage; barracks and hospitals damp during rains; other arrangements, same as at Kirkee; bazaar not drained; no latrines in bazaar.

Fig. 1 shows the usual latrine arrangements in barracks.

Fig. 1.—Plan, Elevation, and Section of the Regimental Privy at Kirkee.



9. Water Supply.—At *Kirkee* water supplied from seven wells, averaging 50 feet in depth; wells totally insufficient, often run short (water has to be carried from the river, half a mile distant), contains from 6 to 8 grains of organic and inorganic matter in solution, sometimes as much as 14 grains of organic matter in suspension (in what quantity of water not stated.) Inorganic impurities consist of chlorides of sodium, magnesium, lime, sulphates of soda, magnesia, lime, nitrates of magnesia, lime, carbonates of magnesia, lime, silica; well water raised by leathern buckets, and carried in leather skins by bheesties on bullocks. In cold weather Government pays 433 rupees, and in hot weather 617 rupees monthly to water-carriers. "No such thing as a pump known at "Kirkee," and "all the arrangements are what they may have been 1,000 years "or more ago."

At *Poona*, water obtained from aqueduct, three tanks, and the river, from which it is forced by pumps into camp. In hot weather aqueduct dry, and has

to be fed from wells; some water stored in tanks not drinkable. 280,450 square feet of camp tanks. No precautions against drainage or surface impurities getting into tanks. During the hot weather water is insufficient in quantity; better supply absolutely necessary; well water raised by common leathern buckets, distributed in leathern skins by bullocks, and on the backs of bheesties. "Each individual has his bheestie, and each regiment its set of "bheesties." *Poona and Kirkee.*

10. Ablution and Bath Rooms.—*Kirkee.*—Lavatories merely open, paved, verandah rooms, with tubs "amply supplied with water." Waste water runs into tubs placed outside. Two lavatories generally to each barrack.

Poona.—Lavatory arrangements the same. No baths.

11. Intemperance.—*Kirkee*, usually temperate; only 3 out of 580 men habitual drinkers; 10 others get drunk on every available opportunity; one admission into hospital in 361 caused directly by intemperance; drunkenness always punished; spirits sold in canteen, but forbidden to soldiers in bazaar; two drams per man per diem allowed; in moderation and diluted, spirits not injurious to health; but drinking interferes with efficiency; sale should be abolished in bazaars, but not in canteens; malt liquor or wine considerably less injurious; spirits produce same effect on system as elevated temperature.

One in 200 confirmed drunkards; one admission out of 113 (into hospital) caused directly, and 1 in 28 indirectly, by intemperance. Other information same as at Kirkee; it is considered that "canteen system might be improved." *Poona.*

12. Instruction and Recreation.—Ball courts (not covered); schools; library; reading room. The following, though much required, do not exist:—No day room; no club; no gardens; no workshops. There is no theatre; no skittle ground; no gymnasium. Persuasion and personal influence used to keep the men from exposing themselves. Foils, single sticks, &c., much required. No sufficient shade. Savings banks are advantageous. *Kirkee.*

Ball court (uncovered); skittle ground; schools; library and reading room; the latter, being attached to the schools, are objectionable, though sufficiently lighted. No day rooms; no clubs; no gardens; no workshops; no theatre; no gymnasia. The three latter much needed. Present means insufficient; men confined to barracks from 8 a.m. to 4 p.m.; savings banks beneficial; no shade except verandahs. *Poona.*

13. Hill Stations.—*Kirkee.*—Hill stations should decidedly be selected for troops, "but only as a change of climate." Amount of barrack and hospital accommodation at hill stations totally insufficient. Best elevation, 4,000 feet above sea; but no experience.

Poona.—The same evidence.

14. Hospitals.—*Site* good and healthy. *Kirkee.*

Water supply, by bheesties, as may be needed.

Drainage.—No regular system, "not being allowed by Government regulation;" all refuse water and impurities carried away by sweepers.

Construction.—Floors three feet above ground; no ventilation below; roof water sinks into sub-soil, which is porous; material, brick and lime; roof double tiled; walls single; floor paved; hospital cool; verandahs.

Accommodation.—Two wards for 10 sick each; two for 12 each; two for 28 each; cubic feet per bed, 1,425; square feet per bed, 86.

Ventilation.—Hospital receives full benefit of winds; ventilation by doors, windows, and roof ventilators; scarcely sufficient; air cooled by tatties and punkahs; stoves for dryness in monsoon required.

Cleansing.—Limewashing every three months or oftener.

Privies washed out frequently and deodorized.

Ablution and bath room.—Tubs and basins alone; permanent lavatories with shower baths much needed.

Hospital linen washed by commissariat; means of drying much wanted.

Storage sufficient and dry.

Bedding.—Iron cots, with straw mattress; cocoa-nut shreds recommended instead.

Poona and Kirkee.

Cooking properly done, and sufficiently varied.

Attendance.—Hospital serjeant, ward boys; "sufficient."

Sanitary state good; no hospital disease.

Convalescents.—Sufficient ground for exercise, but no shaded walks or seats; dhoolies used for carrying; no wards; would be desirable.

Female hospital, one (European nurse and native assistant); too small; medical officer attends sick in their own quarters; obstetric ward much wanted.

Poona.

HOSPITALS.—*Sites* generally open; freely ventilated and healthy.

Water supply abundant and wholesome.

Drainage.—"Artificial drainage not allowed; refuse water, &c., carried away "by sweepers."

Construction.—Floors 3 feet above ground; no ventilation beneath; no surface drainage; rain and roof water sinks into porous sub-soil; material, brick, mortar, and mud; thatched and tile roofs; floors of native hospital, clay; of European, flagged; no verandahs in European hospital.

Accommodation.—Two European hospitals of one ward each for 100 and 107 beds respectively, at 1,291 to 1,296 cubic feet, 72 square feet per bed; three native hospitals of one ward each for from 21 to 30 beds; at 1,267 to 1,286 cubic feet, 70 to 71 square feet per bed.

Ventilation by doors, windows, and ventilators; scarcely sufficient; buildings receive full benefit of prevailing winds; air cooled by wet tatties.

Cleansing.—Limewashing whenever required.

Privies.—Same as in barracks; washed out frequently by sweepers and deodorized.

Ablution and bath room consists of tubs and basins; permanent lavatories and shower baths much needed; no bathing places for sick.

Hospital washing by commissariat.

Storage sufficient.

Bedding.—Iron frames, 1 foot 4 inches high, with tape bottoms; straw bedding; blankets and sheeting; natives use their own bedding, simply a small rug or carpet.

Cooking properly done, and sufficiently varied. *Native sick diet themselves.*

Attendance "according to regulation; sufficient."

Sanitary state, "good;" no hospital disease; verandahs required; also separate wards for special cases, and accommodation for hospital serjeant and subordinates.

Convalescents.—Ground for exercise; but no shaded walks or seats; no convalescent wards; highly desirable.

Female hospital too small; very unsatisfactory: obstetric ward and residence for matron wanted; women and children have to be attended at their own quarters.

Belgaum.

1. CLIMATE.—The climate is generally good, but variable. There is no excess either in dryness, moisture, heat, cold, fog, or damp. Dust storms occasionally. General influence of climate on health, good. Most healthy months, January, February, September, August, October, and July.

2. DISEASES OF NATIVE POPULATION.—Fevers, intermittent; bowel complaints; ulcers; bronchial disease; cholera; small-pox. *Causes.*—Imperfect ventilation; want of cleanliness of person and of dwellings; errors in diet; disregard of all hygienic laws.

3. DISEASES OF TROOPS.—The troops here suffer from fevers, intermittent, remittent, continued, ephemeral, eruptive; dysentery, acute and chronic; cholera, sometimes mild, but often most severe; small-pox, mild and virulent; rheumatism, acute, chronic, idiopathic, syphilitic; catarrh affections frequently severe; zymotic diseases most prevalent in hot season, and beginning of monsoon, when weather is hot, close, and oppressive, with frequent calms. Bazaar and native dwellings greatly wanting in cleanliness and ventilation;

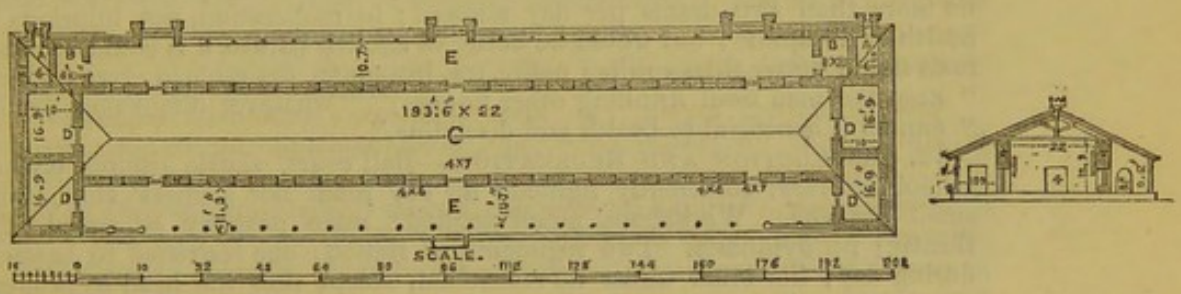
Belgaum.

houses close, crowded, confined, and drainage bad, or very indifferent. European troops at present too crowded; their habits of exposure to sun, frequenting the bazaar, their irregularities and intemperance, tend to excite these diseases. To prevent them the troops should have more space and ventilation; they should be provided with reading-rooms, and means of occupation and amusement to keep them out of the bazaars. The sanitary state of cantonment, bazaar, and native population should be improved; streets widened, dwellings ventilated; impurities removed; vaccination extended. Liver disease prevalent, occasioned by variable climate, exposure to sun, intemperance. Temperance, regularity, suitable clothing, avoidance of exposure, are requisite for preserving health. Venereal disease forms 11 per cent. of constantly sick. Lock hospitals, with proper police measures, might be useful; without these Lock hospitals have been useless, and generally abolished.

4. Bazaars and Native Towns.—Bazaar said to be "well drained;" ventilation, "as in all station bazaars," deficient; houses low and crowded; water said to be "good;" refuse removed by sweepers and carts, and burnt; "no want of cleanliness;" "public privies and cesspools at times very offen-" sive;" native houses near station generally low, mean, and dirty looking, with dung-heaps and cess-pits near them and within the enclosures. Shahpoor about a mile from the station; town of Belgaum, with 18,000 inhabitants, between fort and camp; native town affects general health of station, from "bad "conservancy."

5. Barrack Construction.—Twenty-eight barrack rooms, for from 36 to 72 men per room, at from 813 to 1,430 cubic feet and from 59 to 89 square feet per man. Barracks long and narrow, with verandahs; windows and doors on opposite sides, two rows of beds between. Built of laterite and lime; double tiled roofs; raised from 0 to 8 feet above ground, but without passage for air beneath. Limewashed at no stated intervals. Fig. 2 shows the construction of the infantry barracks, and generally of the more simple forms of barracks in the Presidency.

Fig. 2.—Plan of Infantry Barracks in Camp (9 of this sort).



A A. Urinary. B B. Wash-house. C. Barrack room.
D D D D. Serjeants' room. E E. Verandah open in front.

6. Married Quarters.—"Not sufficient; some of the end verandah "rooms occupied by married men, separate from the unmarried."

7. Ventilation of Barracks.—Small ventilators in ridge; sufficient when barracks not crowded. No means of cooling air.

8. Drainage.—No drainage; fluid refuse received into cesspits; cleared out when necessary; latrines cleansed daily.

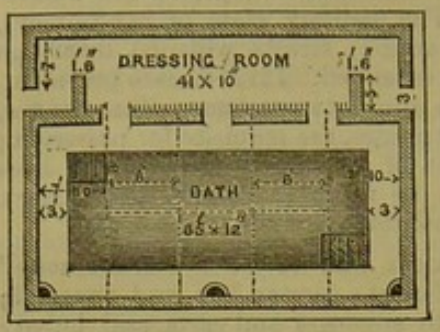
9. Water Supply.—Water from wells liable to pollution both from leaves and other matters falling into them; water good; no unpleasant taste or smell; no chemical analysis; indications under tests of chlorides and sulphates of lime or magnesia, carbonic acid, and iron; quantity limited; raised in leathern skins by bullocks, emptied into troughs, and thence conveyed by water carriers.

10. Ablution and Bath Room.—One or more washing rooms to each barrack; water in casks, filled by water carriers, from which the men help themselves. One plunge bath in fort; two plunge baths in camp, supplied with

Belgaum.

water from wells. Waste water allowed to run by a drain on to the surface of lower ground. Fig. 3 shows the usual construction of these plunge baths.

FIG. 3.—INFANTRY PLUNGE BATH, BELGAUM.—PLAN.



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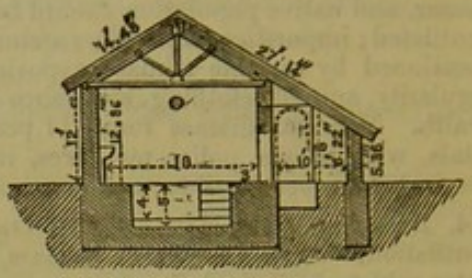

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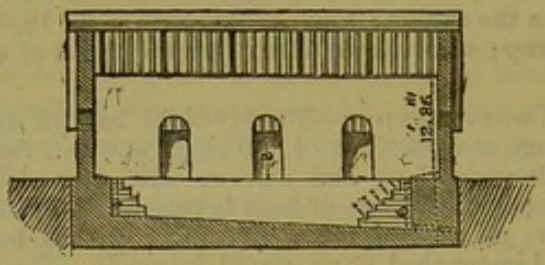


11. INTEMPERANCE.—One in 100 a confirmed drunkard; 14 admissions to hospital last year from intemperance; none among natives; other 15 indirectly from intemperance; spirits sold in canteens; repressed in bazaars, but not stringently enough; quantity consumed, one dram per man per diem; no more than two drams per day allowed; in moderation, not injurious to health or discipline; but would be better to abolish its use, if it could be done; malt liquor better than spirits; coffee, tea, lemonade, desirable in every respect; "keep the men from drinking other liquors;" "whatever diminishes drunk-"enness is beneficial to health and discipline."

12. INSTRUCTION AND RECREATION.—Ball court, skittle ground, cricket, schools, library, sufficiently lighted; no day room nor soldiers' club; some small gardens. Workshops much wanted; none properly so called. No theatre; no gymnasia. Two regiments at station; one *restricted* to barracks during day; the other under no restriction, except that the head be properly covered in going out, and men *discouraged* from exposing themselves; latter rule preferable; too much confinement is bad. Well-behaved men should be allowed to go out shooting and coursing. Not sufficient shade for exercise. Sheds wanted. Savings banks beneficial.

13. HILL STATIONS.—No experience of hill stations; but troops, on going to hills, are liable to head attacks, hepatic affections, and rheumatism; long residence in hills and short residence on plains likely to be most conducive to health of troops.

14. HOSPITALS.—*Sites.*—On the whole good.

Water supply.—Wholesome but limited, "being brought by water-carriers."

Drainage.—No sewers, rain-water everywhere flows on the surface. European hospitals have cesspools, emptied when necessary; sweepers carry away solid matter daily.

Construction.—Floors from two to seven feet above ground; no ventilation beneath; roof water carrried away in open gutters. Material, laterite, and lime; verandahs on both sides, only used for sick when necessary.

Accommodation.—Artillery, two wards, 12 beds each, 843 cubic feet, 60 square feet per bed; European infantry, six wards, 12 to 42 beds each, 892 to 1,598 cubic feet, 69 to 80 square feet per bed; two native hospitals, one ward each, 32 beds, 792 cubic feet, 66 square feet per bed.

Belgaum.

Ventilation, doors and windows, and through the roof; sufficient when not overcrowded.

Cleansing.—Limewashing once a quarter.

Privies.—Cleansed once a day; cesspools always more or less offensive.

Ablution and bath room.—No lavatory; a great want, only tubs and slipper baths, and one shower bath.

Bedding.—Iron cots; straw mattress; straw or hemp pillow; cotton sheets; country blankets of a very inferior description.

Cooking.—Kitchen arrangements sufficient.

Attendance.—"Sufficient."

Sanitary state.—One ward shut out from breeze; privy a nuisance to the other; epidemic disease has appeared; sores sometimes become erysipelatous; buildings too much crowded together.

Convalescents.—No shaded walks nor seats; no wards.

Female hospital.—One; sufficient.

Kolapore.

1. Climate.—Climate of *Kolapore* generally very temperate. Dry from November to February. Early mornings moist and fresh. In March, April, and May there is more moisture. Mean maximum temperature varying from 87° to 88°. Cool and refreshing breezes after sunset. Climate agreeable, though damp and cool during the rains. Altogether one of the healthiest in the Presidency. Diseases most prevalent in September, October, and November.

2. Diseases of Native Population.—Intermittents, remittents; guinea worm; tape, round, and thread worm, and itch; cholera, small-pox, measles.

3. Diseases of Troops.—The more frequent zymotic diseases are intermittent, remittent fevers; epidemic cholera; small-pox; measles; the former occur mostly at the termination of the rains; cholera and small-pox generally in hot weather. Liver disease occurs occasionally, and arises from continued exposure to high temperature and great change; addiction to spirits is a cause of the disease; malt liquor should be used instead. More active habits and daily swimming baths. Lock hospitals recommended. The more varied and agreeable a soldier's occupations the better his health. Indulgence in intemperance is a cause of disease. Present cesspools and urinals should be entirely abolished on account of nuisance.

4. Bazaars and Native Towns.—Cantonment bazaar said to be "clean, "sufficiently drained, and not overcrowded;" sanitary police under the bazaar superintendent; filth and refuse collected in baskets and taken away to be burnt by Government carts; "one sweeper maintained by Government," who collects filth and throws it into a nullah, 400 yards from camp, where "the "bazaar people resort for the purposes of nature;" "stagnant water" removed by sweepers every morning; "two peons" prevent nuisance being committed in camp "from 4 a.m. to 10 a.m. daily," and all offenders are "fined." These arrangements have hitherto proved sufficient. Kolapore, with 50,000 to 60,000 inhabitants, is about one mile, and Bhovra (a village) about half a mile from station.

5. Barrack Construction.—Two artillery barracks for 56 men each, with 811 cubic feet and 58 square feet per man; six infantry barracks for 54 men each, with 792 cubic feet and 56 square feet per man. Barracks, simple construction; one long room, with a serjeants' room at each end; windows and doors opposite; open verandahs, 11 and 12 feet broad. Barracks built of timber framework; space (between posts) burnt brick and mud; roofs single tiled; floors moorum, 2 feet above ground; no ventilation beneath. Bedsteads, some iron; some iron trestles with wooden boards; some of wood; last greatly disliked for the bugs.

6. Married Quarters.—"Sufficient, but of temporary description, and "damp in monsoon."

7. Ventilation of Barracks.—Ventilation as follows:—Outer walls only 6 feet high; space between top of wall and roof fitted with bamboo mat frames; sufficient by night and day, from the strong breezes prevailing. No means of cooling air. Native infantry huts have no ventilation.

8. Drainage.—No drains or sewers; fluid refuse received into cesspits; emptied by sweepers, and purified by lime; small cesspits attached to each

Kolapore.

bathing room, urinal, or privy. To each married man's quarters there is a bathing room, with cesspit.

9. Water Supply.—Water derived from wells; not liable to pollution; amount too limited in the dry season; quality of well water (with one or two exceptions) good and wholesome; no chemical analysis; water raised by buckets and distributed by bheesties.

10. Ablution and Bath Rooms.—Washing places outside barrack verandahs; stone-paved floors; raised masonry platforms for hand basins; water kept in casks supplied by bheesties; waste water runs through urinal to a cesspool, emptied by sweepers; no baths; "lavatory arrangements altogether very "defective."

11. Intemperance.—Five per cent. drunkards in artillery company; six cases delirium tremens in last two years; spirits sold in canteens; one dram and one quart porter issued per man at one time; spirits not injurious in moderation; if suppressed, men would substitute bad country spirit; delirium tremens has been produced here by eau de Cologne sold in bazaars; malt liquor greatly preferable to spirit; tea, coffee, &c., undoubtedly beneficial.

12. Instruction and Recreation.—Skittle grounds; library, well lighted; small garden plots; station theatre; "has fallen down since the pre-"paration of this report;" no ball courts; no adult school; no day room nor club; no workshops nor gymnasia. Artillery not restricted to barracks; permitted to expose themselves as they please, and to get up cricket matches. Infantry—men restricted to barracks, except on duty. Ball alley wanted, and plunge baths, as "the men have no means of keeping themselves clean properly." Savings banks exist; no shade except verandahs.

13. Hill Stations.—Residence at hill stations would lessen liability to fever, and diminish predisposition to climatic diseases of plains. Troops more liable to diarrhœa in Himalaya than at Bombay hill stations. Bowel complaints might be guarded against "by flannel, pure water, cleanliness, clearing jungle, thorough drainage, and a strict system of conservancy." Advisable that European troops be located periodically on hills, especially on high table lands. Europeans should pass one year in five in a more suitable climate.

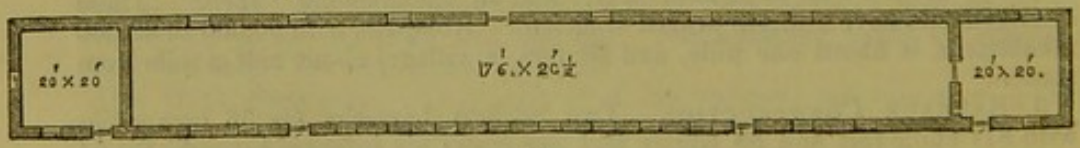
14. Hospitals.—*Site.*—Generally healthy.

Water supply.—Generally sufficient.

Drainage.—None; refuse water runs off, and is either absorbed or evaporated.

Construction.—Floors 3 to 5 feet above ground; no ventilation beneath; roof water falls on ground; part runs down the slope; material, stone and lime; roof double tiled, sufficient for coolness; verandahs, partly used as dispensary and store rooms; only used for sick in extreme cases. Figure 4 shows the construction of a native hospital at this station, with the ward offices usually provided for those establishments.

Fig. 4.—Native Infantry Hospital, Kolapore.



Section.

Accommodation.—One ward, 32 beds, at 1,056 cubic feet, 66 square feet per bed; artillery ward, 16 beds, at 1,100 cubic feet, 69 square feet per bed; native infantry, 60 beds, at 541 cubic feet, 60 square feet per bed; the last originally a gun shed, then a cattle shed, lately converted into a native hospital.

Ventilation.—Infantry and artillery hospitals have revolving cowls in roof; rain beats in and renders wards so damp that charcoal has to be used to keep them dry; with doors and windows, cowls sufficient to allow escape of hot air.

Cleansing.—Limewashing every three months.

Kolapore.

Privies drained into cesspool; regularly cleansed by sweepers, and lime used.

Ablution and bath room.—Artillery hospital, one tub, one slipper bath, one basin to 100 men; European hospital, one tub, one basin to 100 men; "insufficient;" no bath rooms; hospital originally native.

Storage.—Very limited.

Bedding.—Wooden cots; straw mattresses and pillows, cotton sheets, quilts, country blankets, bed carpet; iron cots required; wooden ones greatly disliked from bugs.

Cooking.—Apparatus insufficient.

Attendance.—No hospital orderly in infantry hospital; a matron "sanctioned " only for a complete battalion of artillery or infantry."

Sanitary state, good; no hospital disease; better drainage required.

Convalescents.—No shaded walks or seats; no wards.

Female hospital.—None; treated in their own quarters.

Sattara.

1. Climate.—Generally good for three months. Air hot and dry, but not very exhausting. In the rains fresh, not damp, and equable. With good and well placed barracks it would be healthy for Europeans.

2. Diseases of Native Population.—Fevers, chiefly mild intermittent; sub-acute rheumatism; guinea worm; spleen disease rare; cholera.

3. Bazaars and Native Towns.—Sanitary state of bazaar said to be in every point good; no native houses near; no nuisances; city of Sattara, with a population of 30,000, two miles distant.

4. Barrack Construction.—Thirteen barrack rooms, for 40 men each, at 735 cubic feet and 50 square feet per man. Temporary wattle and daub walls; grass thatched roofs; floors of beaten earth, raised 1 to 5 feet, according to slope. No passage of air beneath. Verandahs all round.

5. Married Quarters.—There are separate quarters.

6. Ventilation of Barracks.—No means of ventilation for barracks insufficient, unless windows always open. No means of cooling air.

7. Ablution and Bath Rooms.—Washing house divided into separate rooms about 8 feet square; no fittings. Water runs into cesspits behind. No baths.

8. Intemperance.—No confirmed drunkards; spirits sold in canteen; prohibited to soldiers in bazaar; quantity varies in different regiments; usually about a dram per man per day; injurious to health and discipline, and should be abolished; malt liquor and wine less injurious; former sometimes necessary; coffee, tea, lemonade, as a rule, preferable; canteens should supply only malt liquor, &c.

9. Instruction and Recreation.—One school; theatre (barrack room); no ball court; no skittle ground; no library nor reading room; no gardens; no workshops; no gymnasia. All wanted. Savings banks exist. Men restricted to barracks during day. No sufficient shade for exercise.

10. Hill Stations.—No experience; but approve of selecting hill stations for troops. Considers "any period of residence in hills, beyond the " acquirement of moderate tonicity, would be injurious."

11. Hospitals.—*Site.*—150 yards from men's barracks; open; freely ventilated; otherwise objectionable.

Water supply sufficient and wholesome.

Drainage.—Surface drains; sewage and refuse cleared away by sweepers.

Construction.—Floors 1½ feet above ground; no ventilation beneath; roof water carried away by trenches; material, wattle and daub; grass thatch roofs; earthen floors; walls too thin; verandahs on both sides; not sufficient.

Accommodation.—Four wards; 12, 20, 26 beds per ward; 870, 890, 960 cubic feet per bed, 60, 61, 66 square feet per bed.

Ventilation by windows and openings under eaves; not sufficient; no means of cooling.

Cleansing.—Whitewashing three or four times a year.

Privies cleaned by sweepers.

Ablution and bath room.—A washing room; "sufficient."

Storage sufficient and dry.

Bedding.—Iron bedsteads; rice straw mattress and pillows.

Cooking "properly done."

Sattara.

Attendance.—A hospital orderly, "with occasional help of a comrade."
Sanitary state "good;" no hospital disease; hospitals, "being only temporary, are defective in many points."
Convalescents.—No shaded walks for exercise, nor seats; no wards.
Female hospital.—None.

Ahmednuggur.

1. Climate.—Healthy and dry. Hot months and immediately after the rains are the most unhealthy times. In the former, fevers, head and liver affections prevail. In the latter, diarrhœa and dysentery.

2. Diseases of Native Population.—Intermittents; cholera; small-pox.

3. Diseases of Troops.—Prevailing diseases, fevers, ephemeral, remittent, continued, in the hot months, and intermittent after the monsoon. Dysentery occasions a large proportion of the mortality. Cholera occasional, rheumatism frequent. These, with diarrhœa, catarrh, throat affections, are the common diseases; liver disease prevalent also. Twelve and a half per cent. of total admissions are venereal; after fevers, it is the most common disease. Lock hospitals, to be of use, must have suitable establishments attached to them. Fevers are most prevalent in hot months, and after the rains. Liver disease during the hot months. Almost every epidemic in this cantonment has its origin in the crowded, ill-ventilated, and dirty village of Bhingar. It would be an immense advantage to have it removed. Want of occupation, leading to drink, lays the seeds of disease among the troops; for one man occupied in a barrack, there are six idle. Too great exertion cannot be used to furnish legitimate amusements and occupations. When men are actively engaged in the field in hot weather, there is little sickness or epidemic disease among them.

4. Bazaars and Native Towns.—Surface drainage said to be "good;" water supply abundant; cleanliness said to be "strictly enforced," but no latrines; no crowding; "two carts and two pairs of bullocks carry away the refuse daily, which is thrown from baskets into the cart as it passes;" town of Ahmednuggur, with 36,000 people, skirts the camp; suburb of Bhingar, with 3,000 people, is a continuation of the camp; inhabitants of both "permitted to "answer the calls of nature on the very boundary of the camp;" when wind blows over dwellings to cantonment, "smell of ordure very perceptible;" removal of filth from native privies not duly attended to.

5. Barrack Construction.—Twelve permanent barracks for artillery, 50 men in each, at 1,135 cubic feet and 51 square feet per man. Twelve temporary barracks for infantry, 50 men in each, at 807 cubic feet and 57 square feet per man. Majority of buildings have windows on opposite sides; beds arranged between them; verandahs 10 to 13 feet broad. Part of the broader verandahs taken in to barrack-room. Permanent barracks of brick; temporary, of wood framing; wattle and daub walls; floors of moorum, raised 1 to 2 feet above ground; no passage of air beneath. Walls limewashed once in six months, or oftener, if necessary. Bedsteads, boards on iron trestles.

6. Married Quarters.—Eighty separate quarters for artillery; none for infantry in temporary barracks.

7. Ventilation of Barracks.—Ventilation in permanent barracks by clerestory windows at top of high walls. Temporary buildings have metal and wooden ventilators in ridge. Where walls low, ridge ventilation generally employed. Means sufficient, night and day. No means of cooling air required.

8. Drainage.—No drainage; night soil and all fluid refuse collected in cesspits, 3 feet by 3, at the end of each barrack, and removed daily.

9. Water Supply.—Water from aqueducts brought from foot of hills; said to be good, wholesome, and sufficient; no chemical analysis; water discharged from aqueducts into wells and reservoirs, and raised thence by bheesties.

10. Ablution and Bath Rooms.—A small washing room, 8 feet by 6, attached to each barrack; water, after flowing off washing bench, passes through urinal into cesspool.

11. Intemperance.—No confirmed drunkards; drunkenness always punished; privilege to sell spirits in bazaar sold by auction for 19,560 rupees for natives; two drams per man per day allowed from canteen; injurious to

Ahmednuggur

health and should be abolished; old soldiers might feel the loss, but young soldiers would be benefited "beyond all comparison;" malt liquor preferable to spirit or wine; "the more of it, and the less of spirits used, the better for the men." Spirits should be sold in canteens "only on particular occasions."

12. INSTRUCTION AND RECREATION.—Ball courts; skittle ground; schools; library; reading room; gardens; workshops; theatre. No day rooms; no gymnasia; means sufficient, but not extensive enough. There are savings banks. Soldiers kept in barracks during day. Shade sufficient for exercise, without injury to health.

13. HILL STATIONS.—Experience of hill stations very limited, but "under "certain conditions, should think that hill stations would be beneficial to "European troops." "There should be 12 months' residence."

14. HOSPITALS.—*Site.*—Hospital 200 yards from horse lines; open; healthy as to elevation, drainage, &c.

Water supply abundant and wholesome.

Drainage into cesspits, whence liquid carried away by hand.

Construction.—Floors four feet above ground; no ventilation beneath; roof water sinks into subsoil; material, brick, and tiled roof; cool; verandahs occasionally used for sick; part of them also used "for eating meals in, there "being no rooms for the purpose."

Accommodation.—One ward of 20 beds; at 2,016 cubic feet per bed, 84 square feet per bed; two wards, 20 beds each; at 1,843 cubic feet per bed, 77 square feet per bed.

Ventilation by double sets of windows, one above the other; "sufficient;" no means of cooling, "shutting the wards up by day in hot weather being "sufficient."

Cleansing.—Limewashing every three months, or oftener.

Privies drained into cesspools; contents removed by sweepers; deodorizers employed.

Ablution and bath room.—"Bathing apparatus very simple;" copper hand basins; wooden tubs, with slipper baths for hot water; rooms being enlarged.

Hospital washing at a distance.

Storage sufficient and dry.

Bedding.—Iron cots; straw mattresses; bed clothes according to season.

Cooking "sufficient."

Attendance.—Hospital serjeant; ward boys; "orderly comrades."

Sanitary state, "good;" no gangrene or pyæmia; "cholera has appeared in "hospital, as elsewhere."

Convalescents.—Dining room required; "anything is better than dining in "the wards in India; among other reasons, because flies, a pest of the first "magnitude in India, are attracted by it; such dining rooms are required for "all hospitals;" no shaded walks for exercise; no convalescent wards.

Female hospital.—One, with matron and assistant matron; accommodation not sufficient.

Malligaum.

1. CLIMATE.—Climate is generally dry; very hot during May and June, when the mean maximum ranges from 100° to 104° F. Mornings agreeable to 10 a.m. Cold weather pleasant, with very few fogs. Air pure; dust storms very rare. Troops generally healthy. October most unhealthy month.

2. DISEASES OF NATIVE POPULATION.—Fevers; rheumatism; cholera.

3. DISEASES OF TROOPS.—Prevailing diseases: fevers of the common types, and diseases of stomach and bowels, intermittents most common; muggy hot damp weather predisposes to them. Causes among the troops: exposure to variations of climate, excess of duty, overcrowding of barracks. Prophylactics: daily bathing; flannel next skin; ventilation of barracks; keeping from exposure to sun. Liver disease not so common here as elsewhere; to avoid it are required, spare diet; no beer or spirits, little wine; exercise; flannel next the skin. Venereal disease 2½ per cent. of sick; Lock hospitals, with police supervision, recommended.

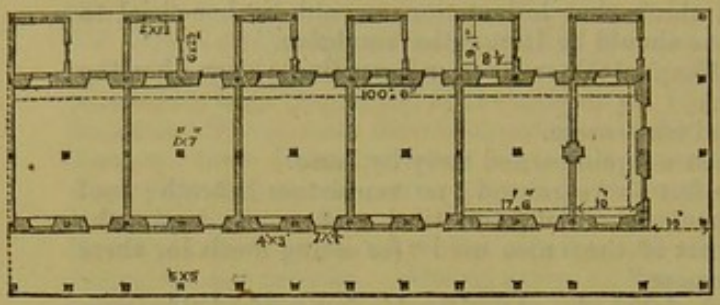
4. BAZAARS AND NATIVE TOWNS.—Drainage and ventilation of bazaar said to be good, and water abundant; streets tolerably open, and cleansed by sweepers under the superintendent; no latrines; town of Malligaum three-quarters of a mile distant.

Malligaum.

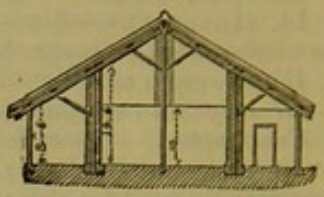
5. Barrack Construction.—Two barrack rooms, one for 90 men, with 1,170 cubic feet and 61 square feet per man; one for 26 men, with 643 cubic feet and 44 square feet per man. Barracks temporary; built of sun-dried brick; roof double tiled; floors moorum, raised one foot, but no passage of air beneath; windows on opposite sides; two glazed shutters; verandahs on both sides and at ends, 10 feet wide. Limewashing when required.

6. Married Quarters.—"Ample and good." The following, Fig. 5, shows their usual construction:—

Fig. 5.—Barrack for Married Men at Malligaum.



Transverse Section.



7. Ventilation of Barracks.—Ventilation by openings in roof; sufficient for day and night, when windows always open. No means for cooling air.

8. Drainage.—No drainage, except surface drainage into nullahs. Drainage of lavatories and urinals insufficient; received into a cesspit 40 feet from the men's quarters.

9. Water Supply.—Water derived from river and wells; quantity unlimited; colour clear and good; tastes slightly of vegetable matter; no chemical analysis; most of water hard; raised and distributed by hand-buckets.

10. Ablution and Bath Room.—Lavatory, with common basins and tubs for washing and bathing; water supplied by bheesties; waste water passes through urinals by covered drain to covered cesspit.

11. Intemperance.—No confirmed drunkards; no canteen; spirits sold in bazaar; malt liquor much better adapted to climate; sale of spirits should be restricted or suppressed.

12. Instruction and Recreation.—No means of instruction or recreation whatsoever; savings banks would be advantageous; no sufficient shade for exercise.

13. Hospitals.—*Site.*—Healthy.

Water supply.—"Abundant and wholesome."

Drainage.—None; "no refuse water lodges in vicinity of hospital."

Construction.—Wards 1 foot above ground; flagged; no circulation of air beneath; roof water sinks into subsoil; material, burnt brick and lime: walls, double; roof, tiled; verandahs all round used for sick and convalescents.

Accommodation.—Two wards, 40 beds each, 829 cubic feet, 50 square feet per bed; two wards, 8 beds each, 872 cubic feet, 62 square feet per bed.

Ventilation by jhilmils, "sufficient."

Cleansing.—Limewashing once in six months or oftener.

Privies over cesspits, kept clean by sweepers.

Ablution and bath room.—None.

Bedding.—None allowed.

Bedsteads.—Wood.

Cooking done in a shed; all that is required.

Attendance.—Hospital orderly and cook; "a comrade if necessary."

Sanitary state, "good;" no deficiencies nor sanitary defects.

Convalescents.—No wards; take exercise in compound.

Female hospital.—None.

Surat.

1. Climate.—The climate is decidedly moist for nine months of the year, the sea being about 10 miles distant. Mean maximum temperature, above 100° F. in March and April; mean minimum in January, 59°. Little or no fog. Occasional dust storms. October till the middle of December is the unhealthy season.

Surat.

2. Diseases of Native Population. — Station, district, and native population generally unhealthy. Prevailing diseases: spleen; small-pox; cholera. *Causes.*—Want of cleanliness; filthy habits; imperfect drainage.

3. Diseases of Troops.—Prevailing diseases, fevers, intermittent, remittent, continued; diarrhœa and dysentery; very little venereal disease, or liver disease.

4. Bazaars and Native Towns.—Bazaar drainage and ventilation "as "good as possible," water from wells; bazaar very small, kept clean under regulations; few native houses; no dungheaps or cesspits; "when wind "blows over native town it is considered unhealthy;" north wind comes over tank, from which there are "noxious vapours;" south-west the only healthy quarter; large and populous city of Surat forms north-east boundary of camp.

5. Barrack Construction.—Three barrack rooms, one for 63 men and two for 25 men each; 480, 540, and 685 cubic feet and 58 and 60 square feet per man. Windows on opposite sides; beds ranged between. Barracks of stone or brick masonry; floors raised from 13 to 20 feet above ground; passage for air, but no thorough draught; no verandahs; floors, chunam and teak planks; bedsteads, wood. Barracks limewashed twice a year.

6. Married Quarters.—Sufficient only for three married non-commissioned officers or men.

7. Ventilation of Barracks.—Ventilation by doors and windows; not sufficient. Air cooled by punkahs.

8. Drainage.—Barracks drained by 4-inch tiles or 8-inch brick and chunam sewers to river from 100 to 350 feet distance. Latrines not drained. Contents carried away by hand.

9. Water Supply.—Not a well containing good drinking water in station, all more or less salt; some very foul with sulphuretted hydrogen gas. Two brackish wells beyond camp contain best water; no chemical analysis. "No "one thinks of drinking the camp water." Raised and distributed by hand in leathern buckets.

10. Ablution and Bath Rooms.—No lavatories; men wash on ground floor; five tubs, supplied daily by bheesties. Drainage carried through walls into river.

11. Intemperance.—No confirmed drunkards; two drams of spirits, or one dram and one quart porter, per man per diem allowed at canteen; no proper restriction at bazaar; no morning dram; spirits decidedly injurious to health; not so coffee and malt liquor; would be beneficial to suppress spirits, and substitute beer, tea, coffee.

12. Instruction and Recreation.—No ball court. A skittle ground and school. No library, nor reading nor day room; no club; no garden; no workshops; no theatre; no gymnasia. Men confined to barracks from 8 to 5 in hot weather. No shade for exercise. Savings banks are advantageous.

13. Hill Stations.—No experience of hill stations; but troops from hill stations are less liable to fevers, &c., on returning to plains. Weak men, on arrival at Mount Aboo, are liable to fever and diarrhœa. Better to locate troops in the hills, with short service on the plains.

14. Hospitals.—*Site.*—Castle hospital has native town on three sides; site not healthy; native hospital, private house; isolated and healthy.

Water supply abundant, and "as good as can be got in the neighbourhood."

Drainage.—"Several drains;" all cleansed daily by sweepers; native hospital cleansed by sweepers.

Construction.—Castle hospital, wards 21 feet above ground; free ventilation beneath; lower ward of native hospital 2 feet above ground; floor, mud: roof water falls on ground and runs away; materials, castle hospital, brick and chunam masonry; floors, chunam; no verandahs.

Accommodation.—Castle, one ward, 10 beds; 760 cubic feet per bed, 76 square feet per bed; one ward, eight beds; 870 cubic feet per bed, 72 square feet per bed. Native hospital, one ward, 12 beds; 1,077 cubic feet per bed, 83 square feet per bed; one ward, six beds; 989 cubic feet per bed, 82 square feet per bed.

Ventilation "good."

Cleansing.—Limewashing once a quarter; no privies in European hospital; one of native hospital cleansed daily, but "highly offensive."

Surat

Ablution and bath room.—Tubs "in sufficient quantities;" "means of bathing "convenient and sufficient."

Hospital washing by native washermen.

Bedding.—Wooden cots; straw mattresses; serge blankets.

Cooking.—Kitchen insufficient; cooking properly done.

Attendance.—Hospital serjeant; ward boys.

Sanitary state "good;" no epidemic disease; European hospital "unfit for "accommodation of European patients;" "native hospital not sufficient;" "new hospital should be erected."

Convalescents.—No wards; no provision for exercise.

Female hospital.—None.

Sholapore.

1. Climate.—At *Sholapore* the climate is warm and dry during the greater part of the year. The mean maximum temperature in April and May is 93°; the lowest minimum is between 69° and 70°; daily range from 7° to 12°. Rainfall, variable, from 13 to 40 inches. Atmosphere pure. High winds at certain seasons. Climate, one of the healthiest in India. Unhealthy months, July, August, December, and January.

2. Diseases of Native Population.—Diseases; quotidian, intermittent fevers; diarrhœa; dysentery; guinea worm; cholera; small-pox. *Causes.*—Neglect of sanitary precautions; impure water; alternations of temperature; improper and insufficient food; abuse of intoxicating drugs.

3. Diseases of Troops.—Prevailing diseases, fevers, quotidian, intermittent, some liver disease, and dysentery, but little cholera; some venereal disease. Lock hospitals *not* recommended.

4. Bazaars and Native Towns.—Bazaar clean, well drained, and ventilated; water from wells not deficient; regulations as to cleanliness sufficient; but no paid establishment for the purpose; no dungheaps or cesspits; town of Sholapore, with 60,000 inhabitants, a mile distant.

5. Barrack Construction.—Two barrack rooms for 40 men each, giving 984 cubic feet and 42 square feet per man; verandah (open) along one side and end of each; doors and windows on opposite sides; beds in two rows; floors raised above ground; no passage of air beneath; where not paved with stone, the floors are of clean gravel and sand, rammed; surface plastered once a week or oftener with cow-dung; windows are ordinary plank shutters; bedsteads iron, or planks on iron trestles; buildings of burnt bricks and lime, with thatched roofs.

6. Married Quarters.—"Such quarters as exist are not creditable to the "Government. Suitable buildings have been estimated for, but no steps "appear likely to be taken for securing the erection of the buildings."

7. Ventilation of Barracks.—Ventilators of different descriptions fixed in ridge of roof of barracks and guardroom. Sepoys ventilate their own huts. Air cooled by tatties.

8. Drainage.—No sewers or drains whatever in vicinity of barracks; all refuse carried away; refuse water from men's lavatories thrown on surface, and evaporates.

9. Water Supply.—Water derived from wells, fed by percolation from tanks, liable to dry up. Houses along the tank margins become most unhealthy; amount of good water limited, contains about 30 grains solid matter per gallon (no detailed analysis); raised and distributed in leathern vessels by bheesties.

10. Ablution and Bath Rooms.—No lavatories; men wash in one end of the barrack verandah. Plunge bath, 30 feet by 20, supplied from reservoir, emptied by drain to nullah, 100 yards off.

11. Intemperance.—Two (out of 76) confirmed drunkards; drunkenness always punished; spirits sold in canteen, but not to soldiers in bazaar; "a man may have either two drams of spirits or two quarts of malt liquor, or "one dram of spirits, and one quart of malt liquor daily;" "soldiers manage "to get drink in bazaars, notwithstanding all endeavours to prevent it;" spirits injurious to health, efficiency, and discipline; would be beneficial to suppress spirits, if men could not get worse; malt liquor much better.

Sholapore.

12. Instruction and Recreation.—Ball court; skittle ground (uncovered); library (lighted at night); school (no trained schoolmaster). Gardens. No day rooms; no soldiers' clubs; no workshops; no theatre; no gymnasia. Men restricted to barracks during day. Workshops a great desideratum; also gymnasia. A large open shed wanted. Savings banks would be advantageous if workshops for trades were established. This would keep many men from canteen. No shade. Verandahs too limited.

14. Hospitals.—*Site.*—Open, freely ventilated.

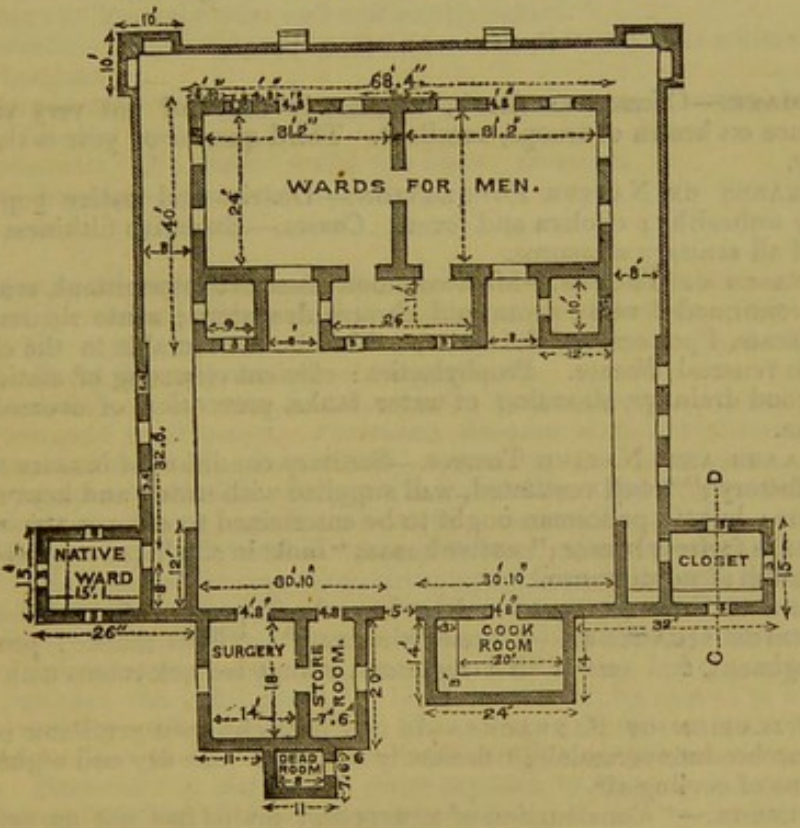
Water supply, excellent, "from a well distant half a mile, conveyed by "bheesties. No necessity for improving it in this respect."

Drainage.—No drains or sewers whatever; all fluid refuse carried away by sweepers.

Construction.—Floors 1 foot above ground; no ventilation below; no means of surface drainage or carrying off roof water; material, burnt brick and chunam; double tiled roof; verandahs.

Fig. 6 gives a plan and section of the artillery hospital, Sholapore, to illustrate the structure and position of wards and offices; it also exhibits the usual hospital provision made for sick wives and children of soldiers.

Fig. 6.—Artillery Hospital, Sholapore.



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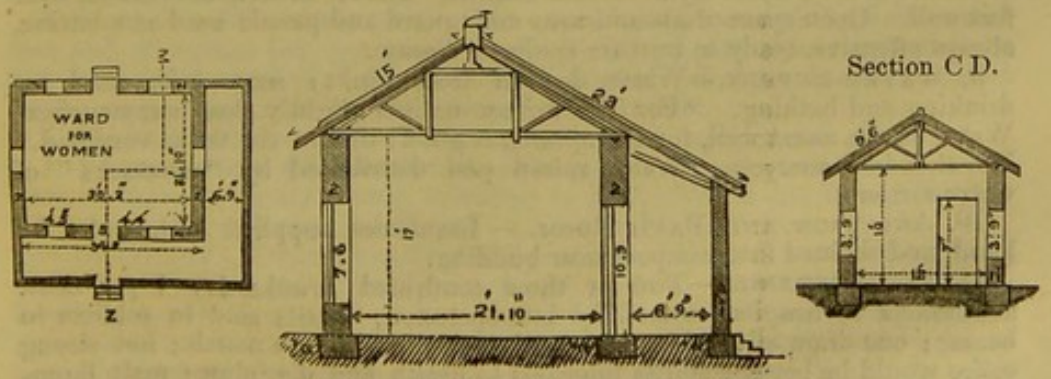


Section C D.

Sholapore.

Accommodation.—Two wards, 10 beds each, at 1,150 cubic feet, 75 square feet per man.

Ventilation.—Iron cowls in ridge, doors and windows; cooled by khuskhus tatties.

Cleansing every three months, or oftener.

Privies cleansed daily by sweepers; "not more offensive than the best of "such places usually are in this country."

Ablution and bath room.—Make shift; there is a bath room, "but all apparatus "entirely wanting."

Hospital washing done by dhobies.

Storage.—"Accommodation in every way susceptible of improvement."

Bedding.—Iron cots; straw mattresses.

Cooking "apparatus primitive; best adapted for Indian cook."

Attendance, "good and sufficient."

Sanitary state, "good;" no hospital disease.

Convalescents.—No means of exercise, except in verandahs; no convalescent ward.

Female hospital.—One ward (in regimental hospital) of 8 beds, at 1,400 cubic feet, 82 square feet per bed. Women prefer remaining in their own huts, and being attended there, with their children, by medical officer; no resident matron allowed; "present arrangement conducive to comfort."

Asseerghur.

1. Climate.—Climate excellent; moderately dry and not very variable. Its influence on health of troops, excellent. Third quarter of year is the most unhealthy.

2. Diseases of Native Population.—District and native population essentially unhealthy; cholera and fever. *Causes.*—Excessive filthiness; total absence of all sanitary measures.

3. Diseases of Troops.—Most common diseases: intermittent, remittent, common continued fevers; acute and chronic dysentery; acute rheumatism; hepatic disease, 4 per cent. of the cases; said to be attributable to the climate. Very little venereal disease. Prophylactics: efficient cleansing of station and vicinity, good drainage, cleansing of water tanks, prevention of overcrowding in barracks.

4. Bazaars and Native Towns.—Sanitary condition of bazaars said to be "satisfactory;" "well ventilated, well supplied with water, and kept clean" by sweepers; but "a policeman ought to be entertained to enforce the regula-"tions in the fortress bazaar;" native houses "built in all shapes and all sizes" in the "pettah;" no nuisance.

5. Barrack Construction.—New barracks in process of construction.

6. Married Quarters.—"None whatever." "Two married people of "28th regiment, and one of 95th regiment, occupy barrack rooms with single "men."

7. Ventilation of Barracks.—In new barracks open ventilator in roof, and open arches into verandah; "decidedly sufficient" for day and night. No other means of cooling air.

8. Drainage.—"Construction of sewers and drains has not as yet been "considered. Sewage will probably be removed by hand." One of the tanks, west side of fort, unsavory at certain seasons. Refuse in all cases thrown over fort wall. Open space of ground near mainguard and parade used as a latrine, always offensive, ready to nurture epidemic disease.

9. Water Supply.—Water derived from tanks; same tank used for drinking and bathing. "For the former natives slightly clear away surface. Water in the sweet well, for Europeans, is good; that in the tanks very bad." No chemical analysis. Water raised and distributed by "mussacks" of water-carriers.

10. Ablution and Bath Room. — Lavatories supplied with water by hand, and drained into cesspool near building.

11. Intemperance.—Two or three confirmed drunkards; 1 per cent. admissions to hospital caused by intemperance; spirits sold to soldiers in bazaar; one dram allowed in morning before breakfast on march; hot strong coffee would be better; spirits injurious to health and discipline; malt liquor

Asseerghur.

better; coffee or tea better than much malt liquor; spirits should be abolished, and beer and coffee substituted in canteens.

12. Instruction and Recreation.—Ball court out of repair; company library; theatre in a private house; no skittle grounds; no day room nor club; no workshops nor gymnasia; men restricted to barracks during day; savings banks "would certainly be advantageous;" no shade except verandahs.

13. Hill Stations.—No experience, but approve of hill stations.

14. Hospitals.—*Site.*—In all respects healthy.

Water supply.—One well only, "good;" filtration required.

Drainage.—None.

Construction.—Floors 14 feet above ground, no air beneath; roof water sinks into subsoil; no gutters round; material, brick, mud, timber, and tiles; verandahs on three sides, used for patients exercising.

Accommodation.—Six wards, 1 to 8 beds each, 21 in all, 724 to 1,275 cubic feet, 60 to 100 square feet per bed.

Ventilation by doors and windows, sufficient.

Cleansing.—Limewashing twice a year.

Privy close to hospital; no drainage; cleansed twice daily.

Ablution and bath room.—One bath room with a large tub; also a mussack, "convenient and sufficient."

Bedding.—Iron bedsteads.

Cooking.—"Properly done and sufficiently varied."

Attendance.—"Plentiful supply of ward coolies;" "comrades when required," hospital serjeant.

Sanitary state.—"Good," excepting the "very dirty and unwashed condition "of the hospital outhouses."

Convalescents.—No shaded walks nor seats; no wards.

Female hospital.—None.

Neemuch.

1. Climate.—The climate at *Neemuch* is cold, dry, and bracing from the middle of November to the middle of February. Heat increases till the middle of May, the mean maximum of the month being 84° F. Fierce hot winds prevail. Great diurnal variation of temperature.

2. Diseases of Native Population.—Fevers prevail.

3. Diseases of Troops.—Prevailing diseases at this station are, fevers, intermittent, remittent; rheumatism, dysentery, and small-pox. Zymotic diseases are most prevalent during the hot weather and rains. No unusual atmospheric conditions have been observed to accompany them.

4. Bazaars and Native Towns.—Sanitary condition of bazaar tolerably good, ventilation and drainage imperfect; water from wells good and sufficient; latrines too close to houses, not used for lack of a proper establishment to keep them clean. People obliged to resort to surrounding country; bazaar sweepers paid by inhabitants; bazaar superintendent maintains "strict supervision," and "punishes the inhabitants." Latrines should be moved to a distance, with a sanitary police to attend to them; native houses more or less dirty, dungheaps close to them; but not sufficiently near station to produce ill effects. Barracks "at east end of camp exposed to disagreeable emanations" from bazaar. "Could be prevented by removing bazaar, or by building new "barracks at west end." Town of Neemuch, with 8,000 to 10,000 inhabitants, half a mile distant.

5. Barrack Construction.—One room for 100 men, giving 1,008 cubic feet and 48 square feet per man; windows on opposite sides; verandah 10 feet wide; floors raised 1 foot above the ground, of stone, laid on rammed earth; no passage of air beneath; temporary barracks.

6. Married Quarters.—Sufficient for present requirements of station.

7. Ventilation of Barracks.—Ventilators in side walls under wall-plate in barracks; guardrooms, openings in roof. When barrack doors and windows shut, ventilation insufficient; air cooled by wet tatties.

8. Drainage.—Drainage quite insufficient and of the very worst description; drainage of privies and urinals only on the surface. Lavatories have percolating cesspools; but soil does not admit of free percolation. These cesspits are within 15 yards of men's quarters. Cook-houses have only surface drainage; fluid refuse of barracks daily carried away by sweepers; bazaar drainage

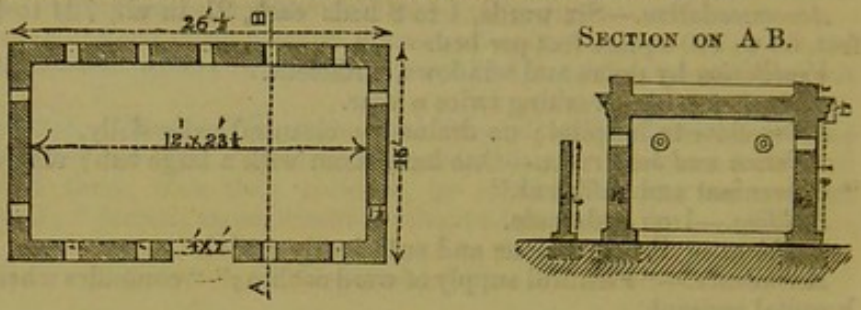
Neemuch.

imperfect; *latrines too close to the houses, and are not used at present for lack of a proper establishment to keep them clean.* People obliged to resort to the surrounding country for the purposes of nature.

9. Water Supply.—There are 39 wells, the water is hard, but good; the amount sufficient; it is raised and distributed by water-carriers; the wells not liable to pollution. (No analysis.)

10. Ablution and Bath Rooms.—Lavatory attached to each barrack, with two baths, one for artillery and the other for infantry; water supplied by duct, from well outside, and drained away by pipe to open watercourse; lavatory appears to have no fittings. Fig. 7 shows the usual nature of this class of ablution accommodation.

Fig. 7.—Plan and Section of a Washing Room, Neemuch.



11. Intemperance.—Soldiers "temperate;" "few confirmed drunkards;" "drunkenness always punished;" spirits sold in canteen, but not permitted in bazaar to European soldiers; one dram a day allowed; use of spirits injurious to health, and "not conducive" to efficiency or discipline; abolition of sale might be injurious to "habitual dram drinkers;" wine or beer beneficial as compared with spirits; coffee, tea, &c. beneficial; sale of spirits in canteen should be prohibited, and and only beer, coffee, or tea allowed; there should be a reading room and coffee shop away from canteen.

12. Instruction and Recreation.—Skittle grounds; schools; library and reading room, former well lighted at night; day room; soldiers' garden; no workshops; no ball courts; no theatre; no gymnasia; former about to be erected; two latter would be a great addition; no shade; men kept in barracks during hot months from 8 a.m. to 4 p.m.

13. Hospitals.—*Site.*—Open, on high ground, sloping away on all sides; healthy as to drainage, elevation, absence of malaria, &c.

Water supply sufficient and wholesome.

Drainage.—Refuse collected in cesspools and carried away at night; night soil removed by sweepers.

Construction.—Floors 3 feet above ground; no passage for air beneath; roof water allowed to run away by natural slope of ground; material, stone, lime, and brick; thick single walls and roofs; no verandahs; wards in two floors; originally built as a residency; rooms of various dimensions; upper floor not used for sick.

Accommodation.—One ward, 30 to 35 sick; cubic feet per bed, 1,600 to 1,870; square feet 62 to 72.

Ventilation.—No windows; all glass doors with venetians; no other ventilation; other smaller wards have ventilators in roof; wet tatties used for cooling.

Cleansing.—Limewashing once in three months, or as often as required.

Latrines like those of barracks; over cesspit; emptied daily.

Lavatories and baths.—Two similar to barrack lavatories, close to hospital; no bath rooms; "ten flat baths."

Hospital linen washed away from hospital.

Storage sufficient and dry.

Bedding.—Wooden bedsteads, infested with vermin; straw mattress and pillow; two sheets, blanket, and coverlid. Iron bedsteads should be substituted.

Cooking.—Two kitchens, close to hospital, not large enough; usual Indian utensils; cooking properly done and sufficiently varied.

Attendance.—Ward coolies; "every severe case allowed a comrade."

Neemuch.

Sanitary state.—"As good as can be expected in a private house." Would "be insufficient for increase of sickness." "Required,"—"cells" for insane patients, hot and shower baths, quarters for medical officers.

Convalescents.—No shaded walks, &c.; "sick carts drawn by bullocks and "elephants." No wards for convalescents.

Female hospital.—A small temporary hospital for females; too small; insufficiently ventilated; otherwise unsuitable.

Nusseerabad.

1. Climate.—The climate at *Nusseerabad* is dry during the hot and cold season, moist during the monsoon; fogs rare; dust storms very frequent in hot season. In May, June, and July the thermometer in the barracks ranges from 102° to 103° F. During the monsoon it is from 78° to 86°. The cold during the cold months is very sensibly felt. Europeans may be all day in the open air without injury from the sun. September to December inclusive are the unhealthy months.

2. Diseases of Native Population.—Fevers; guinea worm; small-pox; dysentery; diarrhœa; spleen; cholera occasional.

3. Diseases of Troops.—At this station fevers afford the largest proportion of admissions. They are intermittent, remittent, and continued; acute and chronic dysentery, distinct and confluent small-pox, and acute and chronic rheumatism also prevail. Cholera is comparatively rare. Precautionary measures required are, cleanliness of cantonments, abundance of pure water, sufficient accommodation for troops to prevent overcrowding, care as to rations, &c. The principal causes of hepatic disease are, intemperance, atmospheric changes, exposure to draughts during perspiration after exercise. The preventive measures are, temperance, cool atmosphere, careful diet, avoidance of draughts. Guinea worm prevalent, from drinking water containing ova. Five-eighths of cases in hospital are venereal.

4. Bazaars and Native Towns.—Station bazaar contains 15,000 people; main and cross streets have covered drains, emptying into nullah on west; part of bazaar much crowded; ventilation bad; 25 latrines, kept clean by sweepers; only one scavenger's cart allowed (for 15,000 people); five required; drinking water chiefly from tanks; 30 wells in bazaar, but only six contain drinkable water; in very dry seasons no drinking water procurable within a mile; each inhabitant responsible for cleanliness of street opposite his house; refuse collected in basket and removed by cart; no nuisance.

5. Barrack Construction.—Barrack accommodation, temporary, consists of nine rooms, each containing 80 men, with 1,000 cubic feet and 50 square feet per man. Barracks have a single open verandah; windows and doors on opposite sides, beds being arranged in two rows between them. Foundations, plinth, and main walls stone and lime, plastered outside. Floors of flag stone, chunam, and moorum, raised from 1½ to 2½ feet above ground; no passage of air beneath; verandahs occasionally used as sleeping accommodation. Bedsteads of wood and of boards and trestles; cotton mattresses, which get damp during monsoon; bedsteads harbour bugs.

6. Married Quarters.—Not yet quite sufficient, but will be provided.

7. Ventilation of Barracks.—Ventilation by doors and windows; small apertures in wall near floor; similar apertures 5 feet above each window; sufficient for night and day, but method objectionable on account of draughts in monsoon and cold weather. Air cooled by punkahs and tatties.

8. Drainage.—None but surface drainage; always damp during monsoon. Each wash-house, cook-house, and urinal has its own cesspit; contents removed when required. Hospital cesspit 125 yards from men's quarters; barrack cesspit not 20 yards from quarters, 97 feet from hospital. Bazaar streets have covered drains, emptying themselves into a nullah west of bazaar.

9. Water Supply.—Water derived from wells and tanks; 2,899,125 square yards of tank surface within half a mile of station; nearly all tanks dry at end of hot season; European troops obtain drinking water from village wells 1¼ miles from barracks; eight other wells in camp, water from which contains so large a proportion of salts as to be unfit for use; water is clear, but brackish; "flavour varies according to quantity of salts," amount varying remarkably at different times. Several times water pronounced wholesome by natives was found to contain $\frac{1}{200}$ of saline and vegeto-animal impurity, chiefly chlorides

Nusseerabad.

and sulphates (no detailed analysis). Water is raised by ropes and buckets, and is distributed by bheesties in "mussacks," and also by water carts.

10. Ablution and Bath Rooms.—Ablution rooms supplied with tubs; water brought daily by carriers.

11. Intemperance.—Temperate; very few drunkards; drunkenness always punished; spirit sold in canteen, but not to European soldiers in bazaar; one quart porter, one dram arrack daily, allowed; or two drams arrack and no porter; spirits in moderation not injurious to health or discipline; should not be abolished altogether; effect of malt liquor or wine depends on constitution; better for men to drink wholesome canteen spirit than bad bazaar spirit.

12. Instruction and Recreation.—One ball court; skittle grounds. "Schools and schoolmasters exist, but schools have to be built." Libraries. No proper reading rooms; no day rooms; no soldiers' clubs; no workshops. There are gardens. A theatre, constantly used; a gymnasium; races; jumping, and other gymnastics. Workshops for trades would be a great benefit. No sufficient shade.

13. Hill Stations.—Advisable to select hill stations for troops; but no experience.

14. Hospitals.—No hospital; only temporary accommodation in barracks and in the church bungalow; three buildings at present used by different arms.

Water supply "good;" carried by bheesties.

Drainage by cesspits.

Construction.—Floor 1½ feet above ground; no ventilation beneath; roof water discharged on ground.

Accommodation in artillery hospital, one room, 14 beds, at 1,527 cubic feet, 76 square feet per bed; four verandahs; all used for sick, when necessary; three small "bedrooms," one bed each.

Ventilation.—Doors, windows, and openings in walls; exposed to prevailing winds.

Cleansing.—Limewashing on requisition.

Privies cleansed daily.

Ablution and bath room "insufficient;" four wooden tubs and four "gindees" to each, besides 40 crockery basins; no baths.

Hospital washing by native washermen.

Storage insufficient.

Bedding.—Chiefly wooden bedsteads, some iron; straw mattresses and pillows, cotton sheets and coverlids, blankets.

Cooking "sufficient;" sometimes want of good vegetables.

Attendance.—Usual regimental establishment.

Sanitary state.—No hospital diseases. Hospital should be larger, better raised, better fitted up.

Convalescents.—No wards; convalescents sent to barracks and put on barrack rations; "marched out under a non-commissioned officer for morning and "evening exercise."

Female hospital.—None; only two compartments of married quarters.

Mhow.

1. Climate.—The climate of Mhow is good; dry and cool. The mean maximum temperature of April and May is 92° to 95°; the mean minimum in December and January is 65° to 67°. Rainfall, from 18 to 24 inches. Little dust. Health of troops affected during changes of season. Monsoon month the most unhealthy.

2. Diseases of Native Population.—Fevers; spleen; small-pox; cholera.

3. Diseases of Troops.—Fevers, intermittent, remittent, continued, are the most prevalent diseases; dysentery and cholera also occur; rheumatism occasionally; liver diseases frequent; stimulating food and drink are predisposing causes. Prophylactics: improve the vegetable proportion of the ration, and substitute malt liquor for spirits. Epidemic disease always aggravated by irregular habits, crowding in barracks, and inferior accommodation. Venereal disease from 60 per cent. of the sick down to 8 per cent. Lock hospitals and a good conservancy police should be established.

4. Bazaars and Native Towns.—Drainage of bazaar said to be "good," and water plentiful; external ventilation not good, because streets not well

Mhow.

arranged; houses said to be generally good; no dungheaps or cesspits; no nuisance experienced; "conservancy carts" remove refuse.

5. Barrack Construction.—Barracks temporary. New stone barracks about to be built, apparently on the regulation plan. Two floors; windows and doors on opposite sides; each barrack to contain 264 men; distance between opposite windows, 50 feet; two intervening rows of piers and arches. Four (4) rows of beds between opposite windows. Construction bad as regards ventilation, agglomerating numbers together, and as to small superficial space.

6. Married Quarters.—In temporary patcheries.

7. Ventilation of Barracks.—Ventilation by openings in roof, sufficient by night and day for temporary barracks. No means of cooling air required.

8. Drainage.—No drainage or sewerage. Drainage received into cesspits 50 feet from nearest quarters, and removed by carts and bheesties.

9. Water Supply.—Water from wells, not plentiful, but good; composition varies, but pure wholesome water can always be procured; no chemical analysis. Drawn and distributed by bheesties in usual manner.

10. Ablution and Bath Rooms.—Three washing rooms, called baths, drained into cistern behind. No fittings.

11. Intemperance.—A few drunken men; drunkenness punished; three quarts of malt liquor, without spirits, or two quarts with one dram of spirits, or one quart with two drams arrack, may be purchased daily at canteen, but none by European soldiers at bazaar; spirits seldom "conducive," not rarely very injurious, to health and discipline; sale should be restricted or abolished; malt liquor or wine more beneficial; coffee, tea, soda water, better than either; soldiers obtain bazaar spirits, in spite of the above enormous quantities allowed, and in spite of all restrictions.

12. Instruction and Recreation.—Ball courts, skittle grounds (uncovered), school, library and reading rooms. No day room, club, nor gardens; no workshops nor gymnasium. A theatre. Savings banks answer. Shade insufficient for exercise.

13. Hill Stations.—No experience of hill stations, but "undoubtedly it "would be desirable to locate troops on the hills as much as possible."

14. Hospitals.—No proper hospital accommodation; present hospital will be abandoned as soon as any can be provided; all the arrangements temporary.

Baroda.

1. Climate.—The climate of Baroda is moist and very damp in the rains; fogs in the end of November; hot winds and dust in the hot season; climate deleterious to the troops. From November till June is the most healthy period; the remainder of the year unhealthy.

2. Diseases of Native Population.—Cholera; intermittents; small-pox; leprosy; spleen disease. *Causes.*—Want of cleanliness; bad drainage; too many trees. The villages in Guzerat are excessively filthy; no cleansing; water stagnant in every hollow till it evaporates.

3. Diseases of Troops.—Fevers are very prevalent at this station; the continued form frequently occurs. Diseases of the stomach and bowels, including dysentery and diarrhœa, are not so frequent; but epidemic cholera has been prevalent. Fever appears about October, when vegetation is decaying, and there is moist muggy heat. Cholera appears about the end of the hot season, and seems connected with the eating unripe fruit by the troops. Hepatitis occasionally occurs; small-pox and rheumatism not common.

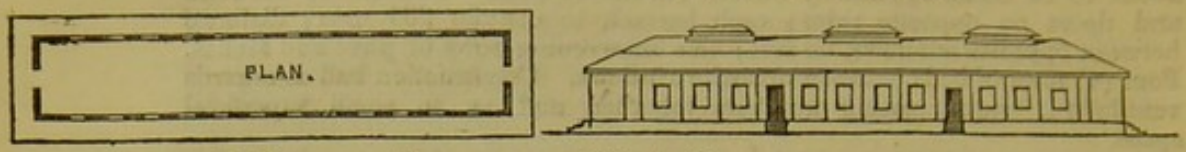
4. Bazaars and Native Towns.—Bazaar well drained; badly ventilated; much crowded; streets clean, but very narrow for want of space. Inhabitants required to keep their premises clean; sweepings removed daily. Four peons allowed; sufficient for sanitary police; no nuisance to station. City of Baroda, 1½ miles distant.

5. Barrack Construction.—Four temporary barracks for 60 men each; 933 cubic feet, 66 square feet per man; built of burnt brick and mortar, sun-dried brick and mud. Floors, some of brick, some of chunam, raised 4 feet above ground. No passage of air beneath, verandahs all round. Two rows of beds between opposite windows; walls and ceilings washed whenever required.

Baroda.

Figure 8 shows the general construction of the temporary barracks at this station and elsewhere in the Presidency.

FIG. 8.—TEMPORARY BARRACK AT BARODA.



6. MARRIED QUARTERS.—"Plenty."

7. VENTILATION OF BARRACKS.—Ventilation by openings in roof of barracks, sufficient; air cooled by punkahs and tatties.

8. DRAINAGE.—Roof water carried off by shallow ditch excavated round buildings; no other drainage; fluid refuse of barracks received into cesspits in rear of cook-houses, 40 yards from barracks. Nullahs with stagnant pools on all sides of station, averaging 400 to 500 yards from barracks; lavatory drainage goes into an open ditch 7 or 8 yards from the room; latrines cleaned by sweepers.

9. WATER SUPPLY.—Water from wells; supply unlimited; clear, without taste or smell; soft, good quality, and contains no lime salts. The solid contents are mostly chloride of sodium, carbonate of soda, bicarbonate of soda, and a faint trace of lime. (No detailed analysis.) It is raised in leather buckets by manual and bullock labour, and distributed by water-carriers.

10. ABLUTION AND BATH ROOMS.—Long narrow wash-house, with a sink extending its whole length; a tub is used for washing; water carried by bheesties, and drained away into open ditch 7 or 8 yards from room.

11. INTEMPERANCE.—Men, as a rule, "temperate;" several "hard "drinkers;" no confirmed drunkards; a large amount of fever cases indirectly caused by intemperance; in hard drinkers, "time after time;" drunkenness "always punished;" one dram of arrack and one quart of porter per man can be purchased per diem; spirit in moderation not injurious to health or discipline; but most of the crime attributable to it; malt liquor preferable to spirits; lemonade, soda water, &c., not used; if spirits prohibited in canteen, worse liquor would be bought secretly.

12. INSTRUCTION AND RECREATION.—Small library and reading room, not lighted at night; cricket; no ball court; no skittle ground; no school; no day room; no club; no garden; no workshops; no theatre; no gymnasia. Workshops, especially for carpenters, much needed; also more suitable books for library. There are savings banks.

14. HOSPITALS.—*Site* to leeward of station; much too close to river and horse lines.

Water supply abundant and good.

Drainage.—By a barrel drain to a nullah.

Construction.—Wards raised 1½ feet above ground; no ventilation beneath; no provision for carrying away roof water; hospital built of brick and mud; verandahs 8 feet broad all round.

Accommodation.—Four wards for 30 beds each, giving 1,042 cubic feet, 72 square feet per man.

Ventilation.—No winds except those which have previously passed over the whole crowded station; proper ventilation next to impossible; windows, doors, and ventilators in roof; sufficient as to means; punkahs in hot weather and tatties.

Cleansing.—Limewashing whenever required.

Privies, same as barracks; "properly cleansed."

Ablution and bath room, "very good;" "a large room; tinned copper "washing basins;" "a large tub kept constantly full by a bheestie for those "men who are sufficiently well to avail themselves of it for bathing."

Hospital linen washed by dhobies.

Storage sufficient and dry.

Bedding.—Iron cots 18 inches high; sacking bottoms; straw mattress; coir recommended instead.

Cooking. Utensils same as in barracks; "well done, and means sufficient."

Attendance.—Hospital serjeant and ward boys; "serious cases have an European orderly."

Baroda.

Sanitary state most objectionable, as being close to a nullah used as a necessary by the natives, and as a receptacle for the filth of the whole station; when cholera occurred, hospital had to be evacuated; "sanitary recommendations of "medical officers always attended to."

Convalescents.—No exercising ground or seats; only verandahs; no wards; "not required; convalescents live in their barrack rooms."

Female hospital, one; no matron, "therefore sick women and children "attended at home; present arrangement sufficient."

Deesa.

1. Climate.—At *Deesa* the mean maximum temperature is above 105° F. in May; heat and dryness extreme; atmosphere often loaded with dust; little rain. Climate must be considered as rather healthy, but becomes exhausting after two years' residence. The healthy months are from November to April inclusive; remaining months unhealthy.

2. Diseases of Native Population.—Diarrhœa; fever, intermittent, remittent; spleen disease not common; cholera "visited many villages in "surrounding districts;" small-pox occasional; but "natives generally "healthy" from "dry climate," sandy soil, and good water, absence of vegetation and of sudden changes of temperature.

3. Diseases of Troops.—The prevailing diseases here are fevers, intermittent and remittent. Dysentery is not common. Diarrhœa most frequent in wet weather. Cholera excessively fatal. In the wet seasons fevers assume the above-mentioned types; and in the hot dry months the types are ephemeral or continued. Liver disease is very common, and is attributed to excessive heat and sedentary habits. Venereal disease amounts to from 13 to 25 per cent. of the admissions.

4. Bazaars and Native Towns.—Bazaar a single street along river bank; surface drainage only; ventilation of houses defective on account of structure and position; water abundant and good. Cleanliness defective except in main street; no latrines; natives resort to nullahs and river bank. Crowding in proportion to poverty. People ill-fed, worse clad; general cleanliness enforced in bazaar. Dungheaps a "never-failing condition of native "life in India." Whether cesspits are in use or not "depends on nature of "ground and weather." Nuisance in native lines from wind coming over native dwellings. Sudder bazaar, with 9,000 inhabitants, inside cantonments and extending outside.

5. Barrack Construction.—Eight barrack rooms contain 70 men each, and three contain 80 each, with from 1,100 to 1,200 cubic feet and 59 square feet per man. Space between windows for two beds 6½ feet wide. Verandahs 10 feet wide on all sides; used by soldiers to sleep in at their discretion; two rows of beds between opposite doors and windows; materials, burnt brick and mortar; floors concrete, raised 2 feet above ground. No passage for air beneath. Limewashing done at no stated period. Bedsteads, iron trestles and boards.

6. Married Quarters.—84 for European regiment; 14 for troop, horse artillery.

7. Ventilation of Barracks.—Ventilation of barracks by punkahs, doors, windows, and ventilators in roof; scarcely sufficient for crowded barrack.

8. Drainage.—Barracks drained by small square underground drains into circular cesspools, 2 feet diameter and 10 feet deep; emptied as found necessary. Drainage not sufficient; fluid refuse of barracks sinks into subsoil; bazaar has open channels or surface drains; no bazaar latrines.

9. Water Supply.—Water, from wells, abundant, clear, agreeable, devoid of smell. Chemical composition not known. Drawn for use in leather bags, lowered over rollers, and pulled up by bullocks and distributed by bullocks and carriers.

10. Ablution and Bath Rooms.—Each barrack has an ablution room, but no convenient fittings for washing. Two plunge baths, 50 feet by 20, for European regiment; one smaller bath for horse artillery.

11. Hill Stations.—Mount Aboo, 45 miles distant, over a level sandy plain. Ascent by bridle path in about two hours; elevation 4,000 to 5,000 feet. Climate favourable to residents and to children of Lawrence Asylum. Approve of hill stations, but they require care; scurvy, scorbutic dysentery, general cachexia, and anæmia have resulted from want of variety and deficiency

Deesa.

of vegetables in ration. "Last year a company of men returned from Mount "Aboo after a year's residence, suffering from intermittent fever, caused by "bad barracks and unhealthy malarious position." The men were "reduced "and anæmic from malarious poison, and somewhat scorbutic from defect in "diet. Mutton was the only meat issued for 12 months." "At some hill "stations there is malarious fever; others predispose to diarrhœa." Barracks and hospitals at hill stations of Kussowlie and Subathoo are defective in structure and plan. At Aboo the barracks were erected in a malarious gully.

12. HOSPITALS.—*Site.*—Two hospitals; European hospital on highest and best ground in cantonment, but too near officers' quarters, which obstruct the breeze; artillery hospital on lower ground; ventilation similarly obstructed.

Water supply abundant and wholesome.

Drainage by cesspools 10 feet deep; emptied as found necessary.

Construction.—Ward floors 18 inches above ground; no ventilation beneath; no surface drainage; roof water sinks into subsoil; material, burnt bricks and mortar; tiled roofs, which are hot; verandahs all round; sometimes used for sick.

Accommodation.—European hospital, two wards, six beds each; 1,822 cubic feet per bed, 104 square feet per bed. Four wards, 12 beds each; 2,005 cubic feet per man, 114 square feet per man. Horse artillery hospital, two wards, 16 and 7 beds each, with 2,387 to 1,445 cubic feet per man, 108 to 65 square feet per man.

Ventilation.—By doors, windows, punkahs, and ventilators in roof; generally sufficient.

Cleansing.—Limewashing when required.

Privies over cesspits.

Ablution and bath room.—In infantry hospital: sheds projecting from verandah, with tables, basins, chatties, and towels; sheds interfere with ventilation of wards. Arrangements in artillery hospital insufficient; means of bathing: chatties, tin baths, and basins; not sufficient nor convenient.

Hospital washing.—By washermen.

Storage.—Sufficient and dry.

Bedding.—Iron bedsteads; rice, straw, or cotton mattresses; "hair or cocoa-"nut fibre preferable;" counterpanes, blankets, sheets.

Cooking.—By Portuguese; tolerable.

Attendance.—"Ample and sufficient;" orderlies from regiments employed "during epidemics or in particular cases of importance."

Convalescents.—Shaded walks for exercise; horse exercise; no wards; such are necessary.

Sanitary state.—"Excellent;" no hospital disease; but hospitals are too small; no deadhouse; no guardhouse; "men on guard occupy a corner of "front verandah, where they eat, drink, and smoke at their discretion."

Female hospital.—One; arrangements satisfactory.

Hyderabad (Scinde).

1. CLIMATE.—At *Hyderabad* (in Scinde) the thermometer rises in May and June to 99° F. The rainfall is of very limited amount; the atmosphere exceedingly dry; evaporation rapid for seven months in the year; weather pleasant and bracing in December and January; depressing and exhausting in hot season; predisposes Europeans to disease, but is not an exciting cause; changes of season unhealthy; malarious fevers, with lassitude, debility, and chronic abdominal affections, prevail on the change from cold to heat; same diseases of inflammatory type on the change from heat to cold.

2. DISEASES OF NATIVE POPULATION.—Fevers (malarious), with spleen disease, small-pox, measles, calculus. *Causes.*—Poverty, filth, alternate inundations and drying of soil.

3. DISEASES OF TROOPS.—Prevailing diseases among the European troops are, fevers, quotidian, intermittent, remittent; dysentery; rheumatism; hepatitis. They are most prevalent in autumn. European troops at Hyderabad have never suffered from epidemic cholera. Strict attention to all sanitary measures is required. There should be no overcrowding of barracks.

4. BAZAARS AND NATIVE TOWNS.—Drainage of bazaar principally natural; water bought by residents; no crowding; kept clean by sweepers; no dung-heaps permitted; no nuisance in barracks from bazaars; native houses generally good. Native town of Hyderabad adjoins station.

Hyderabad (Scinde).

5. Barrack Construction. — There are ten barrack rooms, holding 96 men each; with 1,849 cubic feet and 86 superficial feet per man; each barrack has two non-commissioned officers' rooms at each end, with a lavatory projecting from the centre; double verandahs and three rows of beds between the opposite doors and windows; verandahs 8½ feet wide; barracks constructed of pucka-brick and lime; floors partly of brick, partly of stone, raised 2½ feet above ground; would be a great improvement for barracks to be raised on arches, "from the well-known habit of malaria, in keeping towards the "surface of the earth;" barracks "cleansed and limewashed twice a year."

Figs. 9, 10, and 11 show a plan, internal elevation, and section of the barracks; with three rows and space for four rows of beds between the opposite windows; these figures illustrate the general construction of this class of barrack.

Fig. 9.

Plan and Sections of one of the European Barracks at Hyderabad (Scinde).

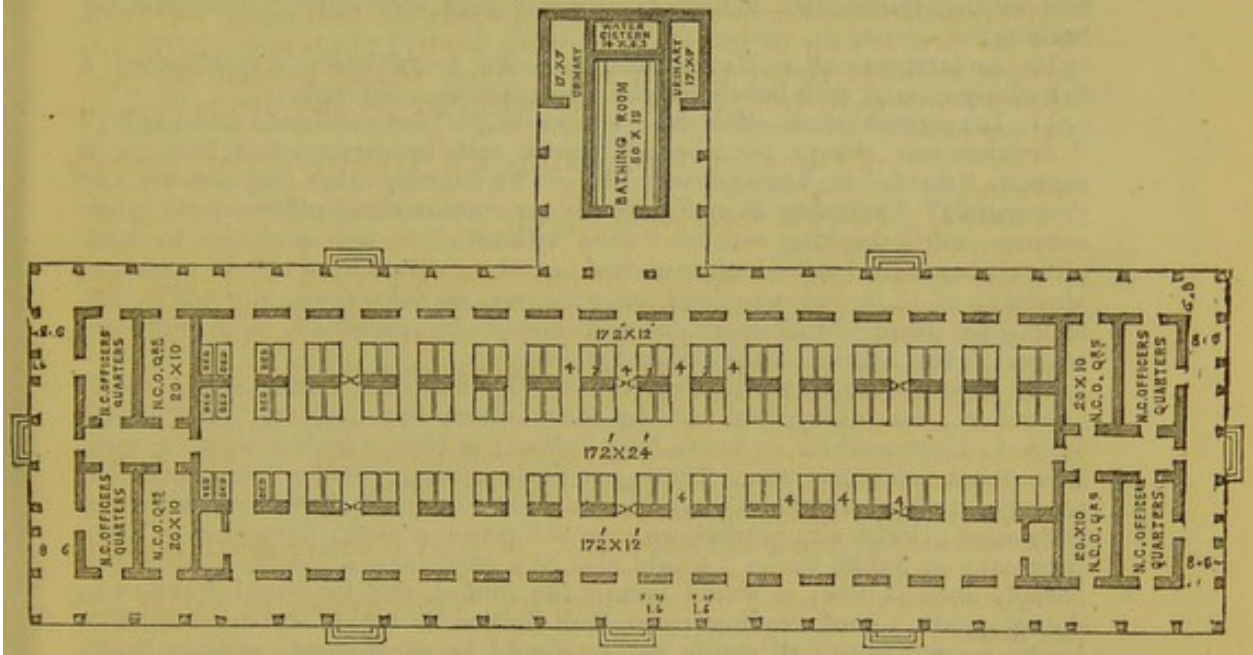


Fig. 11.—Cross Section.

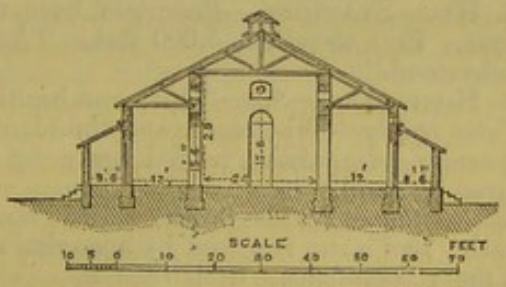


Fig. 10.—Longitudinal Section.

Construction.

Foundations and superstructure are of burnt brick and lime.

Floor of large bricks set in lime.

Roof consists of teak trusses, purlins, rafters, battens, matting plastered over with mud and straw and single tiles on top.

Doors (each 4 ft. by 10 ft.) are partly venetian and partly glazed.

Windows (each 4 ft. by 2 ft.) are fixed venetians.

Each roof is provided with three ventilators, 11 ft. long and 6 ft. broad.

6. Married Quarters.—"Quite sufficient."

7. Ventilation of Barracks. — Barracks, guardroom, &c., have ventilators in roof, sufficient to keep air pure night and day; admitted air cooled by punkahs and tatties.

8. Drainage. — No drains or sewers for barracks; surface and other drainage conveyed into cesspools close to the buildings; emptied as soon as filled. Cesspits, 2 feet diameter, 3 feet deep. No drainage in the bazaar; all

Hyderabad (Scinde).

filth carried away in carts to the kilns and burnt. Every house has a cesspit, emptied daily. Drainage of European lines "in every respect satisfactory;" received into cesspits; cleaned out every night; "contents carried in skins on "bullocks' backs to a distance." Privies cleaned twice a day. In native lines, contents of cesspits are "thrown about in close vicinity to cesspits." "Anything edible is immediately picked up by birds or dogs." "Great room "for reform" in native latrines, cleansing of which consists mainly in the liquid "sinking into the subsoil, so that the earth is thoroughly saturated, and "a noisome odour pervades the atmosphere." "On the whole, the sanitary "condition of the station is satisfactory."

9. Water Supply.—Water supply derived principally from wells filled by the Indus during the inundation. Some wells brackish; majority good. A few wells during the hot weather become dirty and offensive from not being properly attended to. In others less used, pure water is always attainable. Chemical composition not known; water soft; dissolves soap readily. "*No "doubt it swarms with animal life.*" Supply abundant; stored in an open tank; full during inundation, almost dry during May and June. Not used for bathing.

10. Ablution and Bath Rooms.—To every barrack is attached a "bathing room," with benches and a water cistern. No bath.

11. Intemperance.—Soldiers "temperate;" "few confirmed drunkards;" "drunkenness always punished;" spirits sold in canteen and bazaar; in canteen "good," in bazaar "very bad;" "a cunning man may procure any "amount;" "morning dram" depends on commanding officer, quite unnecessary; spirit drinking can be "done without;" is not conducive to discipline; abolition of spirit ration advised, as also restriction of sale in canteens; abolition of it in bazaars; beer or wine not so deleterious, nor coffee, tea, lemonade, &c,; drunkenness should always be punished, and sufficient recreation and amusement provided for men.

12. Instruction and Recreation.—One ball court; one skittle ground; one school; one library and reading room; much too small and insufficiently lighted; light paid for by men; long bullets; cricket. In hot weather, men, save those who can read, "have positively nothing to do;" no restriction on exposure to sun; men always less anxious to expose themselves where no restriction; large airy workshops "would prove a boon to soldiers;" employment on public works "would also be a great boon;" work would be as cheaply done as now; it would occupy the soldier, and he would feel he was doing good; a good reading room, well lighted at night, and more suitable books, a great want; all manly games should be encouraged; savings banks answer admirably; no shade except in north verandahs.

13. Hill Stations.—Reporters have no experience of hill stations, but approve. Best elevation, 5,000 feet. "Acclimatization a myth, as generally "understood."

14. Hospitals.—*Site.*—Open and healthy, 600 yards from barrack.

Water supply.—Wholesome and abundant.

Drainage.—Impurities carried away by open drains into cesspits; thence removed by hand.

Construction.—Wards 3 feet raised above ground; no perflation of air beneath; roof water removed by open drain; material, pucka-brick and lime; tiled roof; verandahs. Built 1854–5.

Accommodation.—Five wards; no regulation number of beds; cubic feet and superficial feet per bed not given.

Ventilation.—No windows; doors with venetian shutters, sufficient to keep wards cool and free of odour. In hot weather wet tatties are used, and punkahs.

Cleansing.—Walls and ceilings limewashed yearly, or oftener.

Latrines.—Over cesspits, cleansed and deodorized; no waterclosets.

Lavatory and bath.—None, except a tub and hip bath.

Hospital linen washed and dried in sun.

Storage sufficient and dry.

Bedding.—Wooden cots 2½ feet high, tape bottoms; beds, chopped straw.

Cooking.—Means sufficient.

Attendance.—Ward boys. "A comrade can always be procured, or a nurse, "on requisition."

Convalescents.—No ward and no exercising ground for convalescents.

Hyderabad (Scinde).

"An unwieldy and uncomfortable cart allowed" "for exercise of convalescents;" "little used."

Female hospitals.—One with matron for each corps.

Kurrachee.

1. Climate.—At *Kurrachee* the climate is good. Maximum heat 86° to 94° F. in May and June. December, January, and February are the cold months; other months variable; fogs at times.

2. Diseases of Native Population.—Sickness occasional at beginning and end of hot season. Diseases, fevers, spleen, bowel, scurvy, ulcers. *Causes.*—Swampy margin of sea; bad drinking water, causing scurvy and diarrhœa.

3. Diseases of Troops.—Prevailing diseases: fevers, intermittent, remittent, and continued; dysentery and rheumatism occasionally. These give 45 per cent. of the total admissions and 33 per cent. of the total deaths. Hepatic diseases at the rate of about 3 per cent., caused by heat and the use of spirits; but also accompany severe fevers and dysentery. Pure air, disuse of spirits, proper clothing, and exercise, are the prophylactics required against hepatic diseases. Twenty per cent. of the sick of European regiments suffer from venereal disease. Prostitutes should be expelled from bazaars, and marriage extended. No Lock hospitals required. About 10 per cent. of recruits landed at Kurrachee from England suffer from scurvy; attributed to bad water and food, and inferior accommodation on voyage.

4. Bazaars and Native Towns.—No drainage in bazaars; filth removed daily, kept as clean as limited number of sweepers will allow. Bazaar very crowded; more sweepers required. Native houses mostly good, with cesspits, but contents removed daily. No nuisance in barracks from bazaar. Town of Kurrachee, with 22,000 inhabitants, 2½ miles distant.

5. Barrack Construction.—Twenty-two European barrack rooms; 10 contain 100 men each, nine contain 47 men each, three contain 50 men each; cubic feet per man from 1,175 to 1,604; superficial feet per man, from 65¼ to 114½; each barrack has a verandah 10 feet wide, and two rows of beds between opposite doors and windows; barracks constructed of stone and lime; floors of cut stone in permanent barracks, chunam and earth in others; floors raised from 3 feet to 3½ feet above ground; no passage of air beneath; walls and ceilings cleansed and limewashed every six months; bedsteads consist of boards on iron trestles.

6. Married Quarters.—"Sufficient."

7. Ventilation of Barracks.—Ventilation by openings in roofs and fixed venetians in walls, by wind shafts, and by open doors and windows; sufficient for day and night. Sea breeze ample for coolness.

9. Water Supply.—Water derived from wells; supply never known to fail. It is rather dull in colour, and has an earthy taste, but no smell. It contains chloride of sodium, sulphate of soda, sulphate of lime, sulphate of magnesia, carbonate of magnesia, carbonate of lime (quantities not given). The best wells contain nearly $\frac{1}{2000}$ of saline matter; quality not good; injurious to health; quantity sufficient; raised by Persian wheels and hand buckets, and distributed by water-carriers in skins and by casks in carts; there are two or three tanks filled by rain; seldom full, often dry. Water should be brought from the Mulleer river or the Indus.

10. Ablution and Bath Rooms.—Plunge bath, 36 feet long, 14 feet wide, 5 feet deep. Smaller bath in horse artillery barrack.

11. Intemperance.—Soldiers "temperate;" about 1 per cent. confirmed drunkards; 1 per cent. of admissions into hospital from delirium tremens; drunkenness punished; spirits sold in canteen and bazaar; prohibited to European soldiers in latter; spirit no part of ration; morning dram not allowed; spirits "not conducive" to health or discipline; certainly often injurious; difference of beer, wine, or spirits on health only one of degree; sale of spirits should be prohibited in canteen; only beer, coffee, tea, &c., should be permitted; should be done gradually, beginning with recruits; "no more than "one dram" of spirits or one quart of malt liquor allowed per man at one issue at present.

12. Instruction and Recreation.—Ball courts; skittle grounds; schools; library and reading room; workshops not efficient; theatre unaided by Government; means not sufficient; no day rooms, nor soldiers' clubs, nor gardens, nor gymnasia; men restricted from exposing themselves to sun; trades and gymnastics should be encouraged; restriction on marriage should

Kurrachee.

be removed; savings banks would be an advantage; no shade from trees, only verandahs.

13. Hill Stations.—Approve. "Hill station is to the plain as the open "air to the hot-house."

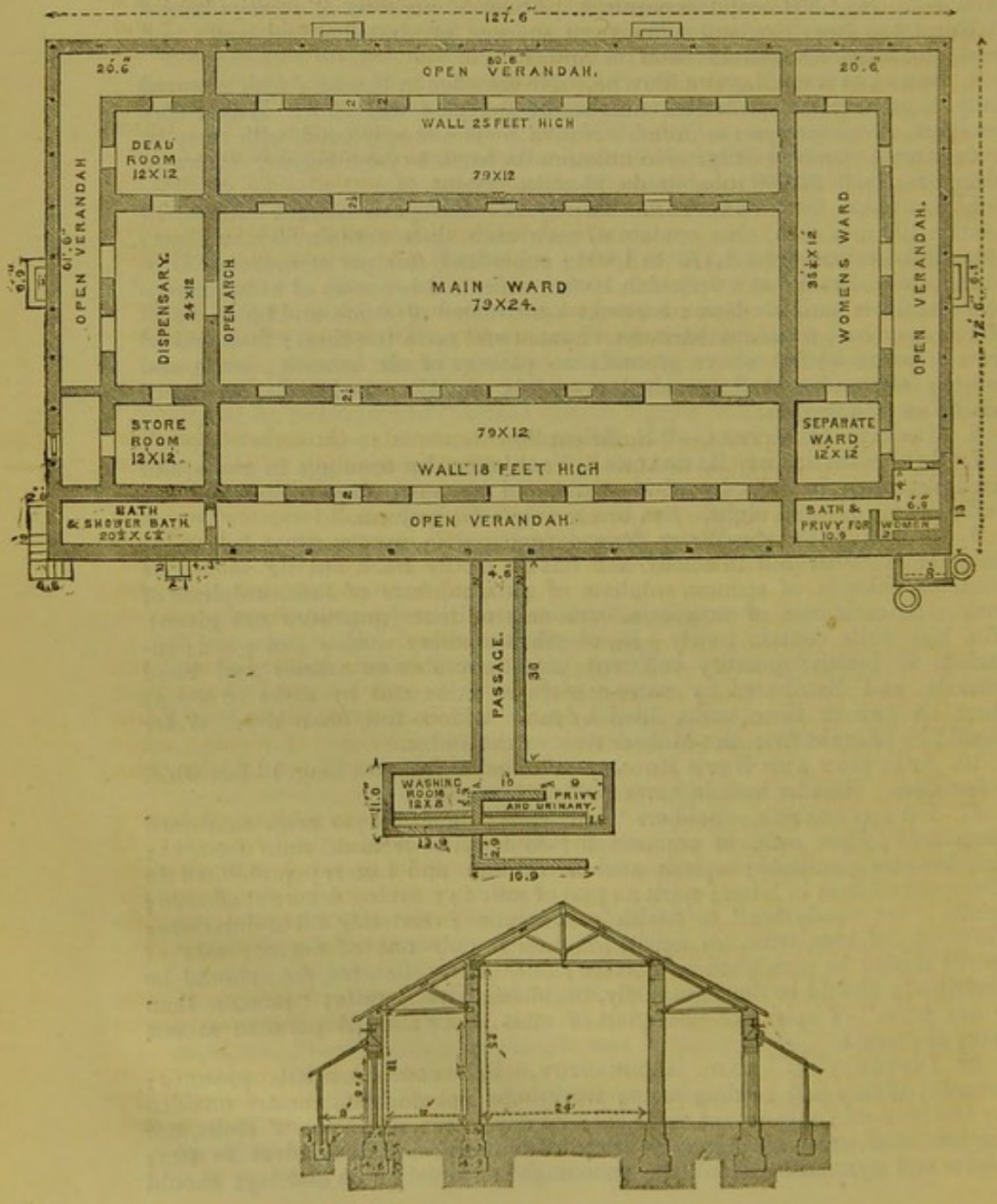
14. Hospitals.—*Site.*—All hospitals, except one, too near to barracks; one very close to picket ground; general hospital 200 yards from bazaar. With these exceptions, sites pretty open, "and healthy as to drainage, elevation, &c."

Water supply.—Abundant, but not good.

Drainage.—None; all refuse removed daily by sweepers.

Construction.—Wards, except in one hospital, raised 3 feet above ground; no passage for air beneath; roof water not carried away; sinks into subsoil; no surface drainage or guttering. Material of older hospitals, sun-dried brick; of new one, stone. Of general and native hospitals, roofs and walls double; of others single; verandahs from 8 to 12 feet broad. In double-walled hospital verandahs are inside; used for sick when wards crowded. Fig. 12 gives a plan and section of the horse artillery hospital at this station, showing one inner ward enclosed on all sides by other apartments, and having no direct communication with the open air.

Fig. 12. Plan and Section of Horse Artillery Hospital, Kurrachee.



Kurrachee.

Accommodation.—Three European and two native hospitals (one ward each), of which four wards contain 100 beds each, and one 28 beds. Cubic feet per bed *in European Hospitals*, 1,362 to 1,867; square feet, 68 to 97. Cubic feet per bed *in native hospitals*, 316 to 633; square feet, 24 to 35.

Ventilation.—By doors, windows, and openings in roof; windows open vertically in halves. Means sufficient in new hospital; not so in old; no means of cooling the air.

Cleansing.—Limewashing once in three months.

Latrines over cesspools; cleansed daily, and quicklime put in. "Not offensive, if carefully kept." "Admit of improvement."

Ablution and bath room.—Sheds with tubs; slipper baths; neither sufficient nor convenient.

Hospital linen.—Washed away from hospital.

Storage.—Sufficient and dry.

Bedding.—Bedsteads iron, but not universally so; wooden cots in European and native hospital (1 foot 2 inches to 1 foot 6 inches high); harbour vermin; straw beds and pillows; sheets, blankets, quilts, according to season.

Cooking.—Portuguese cooks. "The younger and inferior cooks, being paid "less, are found in hospitals."

Attendance.—Hospital serjeant in European hospital; 10 ward boys; one added for every eight patients above 80, and one for every bed-ridden case, "and "a comrade in extreme cases." Sufficient in number, inferior in kind. A havildar and comrades attend in native hospitals.

Sanitary state.—Only one hospital out of five "adequate." Phagedœna and gangrene have occurred from crowding; want of space great defect; better privies and baths, and better ventilation required, also a matron to superintend cooking and distribution of diets. Suggestions of medical officers may be acted on or not by higher authority.

Convalescents.—No fenced ground, shaded walks, or seats for exercise; only vicinity of hospital, or verandah, or ambulance cart to exercise in. No wards for convalescents.

Female hospital.—Separate hospital for women, and children, with matron, assistant matron, and ward women; satisfactory. No female native hospital.

Aden.

1. Climate.—*Aden* has a moist sea climate, equable throughout the year, with a mean temperature in May, June, and July of from 90° to 94° F. Dust storms occasionally. May and September are the most unhealthy months.

2. Diseases of Native Population.—Ulcers; small-pox; fevers.

3. Diseases of Troops.—The most frequent diseases among Europeans here are not those observed at other stations. Fevers, dysentery, rheumatism, cholera, happen occasionally, but in much smaller proportion than elsewhere. The fevers are chiefly ephemeral and intermittent; they are most prevalent, together with diarrhœa and dysentery, in September.

4. Bazaars and Native Towns.—No drains near sudder bazaar, "not "required, ground being elevated and dry." Ventilation good; water from wells; one privy; no nuisance permitted "in unauthorized places." "Peons "see to this." Houses not crowded; "sanitary condition" of bazaar "could "not be improved." No nuisance in barracks from it. Town of Aden, with 25,000 inhabitants, close to military limits.

5. Barrack Construction.—Six rooms for European soldiers, containing 46 men each, at from 1,346 to 1,452 cubic feet per man, and from 60 to 62 square feet per man; the isthmus barracks are built of rubble and chunam, over an arched basement 12 feet high; Front Bay barracks built of wattle and daub, and floors paved and raised 2 feet 9 inches above ground; no passage of air beneath; whitewashing twice a year; barracks have verandahs; two rows of beds between opposite doors and windows.

6. Married Quarters.—Twelve married quarters for infantry; 24 more to be added; 12 for artillery at Front Bay, and 12 at Ras Tarshyne; 24 for infantry also there.

7. Ventilation of Barracks.—Ventilation by teak wood trellis-work in the walls over each door and window; also openings in roof; sufficient for day and night; sea breeze sufficient for coolness. Punkahs recently erected,

Aden.

on account of excessive sickness in a regiment recently arrived from unhealthy Indian stations.

8. Drainage.—All drainage from barracks allowed to sink into subsoil,—very absorbent; contents of urinals and wash-houses received into cesspits, 10 feet diameter, 6 or 7 feet deep; soil absorbs contents. Sudder bazaar not drained.

9. Water Supply.—Supply derived from wells; amount of drinking water limited; will be shortly increased by a condensing machine; it is raised by bullock power and distributed on donkeys and camels. The composition of four wells shows a large amount, apparently from 60 to 80 grains per gallon, of impurity from chloride of sodium, chloride of magnesium, chloride of calcium, sulphate of soda, nitrate of lime, carbonate of magnesia; there are also storage tanks.

10. Ablution and Bath Rooms.—No bath accommodation; men bathe in sea; there are washing rooms, without fittings, in basement.

11. Intemperance.—Soldiers "temperate;" no "confirmed drunkards;" drunkenness "always punished;" spirits sold in canteen and bazaar; average consumption, ¾ dram per man per day; no "morning dram;" spirits in moderation "do no obvious mischief;" amount allowed too limited to do mischief; bazaar spirit bad; sale should be prohibited, but not sale in canteen, because bazaar spirits would be drunk; malt liquor good for health; tea, lemonade, soda water, &c., far better for health, efficiency, and discipline, than intoxicating drink; one dram of spirit or one quart of malt liquor per man issued at one time.

12. Instruction and Recreation.—One ball court; two skittle grounds; two schools; one library and reading room; sufficiently lighted at night; no day rooms; no soldiers' clubs; no gardens; no workshops; no theatre; no gymnasia; no shelter from trees, only verandah; covered gymnasium much wanted; men kept in barracks during day; savings banks beneficial.

14. Hospital.—*Site.*—In every respect healthy.

Water supply.—From wells, principally brackish; better supply is being obtained.

Drainage, none; refuse water absorbed by soil.

Construction.— Floors 3 to 4 feet above ground, paved with stone; no passage for air beneath; roof water sinks into subsoil; material, rubble and chunam, wattle and daub; walls and roofs single, but thick; verandahs on two sides, used for sick when hospital crowded.

Accommodation.—Three hospitals for Europeans; one ditto for natives; former contain in all four wards, with 10, 12, and 20 beds per ward; cubic feet, 900 to 1,872; square feet, 55 to 90 per man. In native hospital, cubic feet, 433 to 565; square feet, 38 to 51 per man.

Ventilation.—Hospital exposed to prevailing winds; air renewed by windows; trellis-work over doors and windows; open ventilators in roof; sufficient; punkahs used for cooling.

Cleansing.—Limewashing once a quarter; privies and urinals 40 to 50 feet from hospital; drained by hand; no cesspits.

Ablution and bath room.—One room for washing and bathing; "sufficient."

Hospital linen washed and dried by washermen.

Storage sufficient, and dry.

Bedding.—Bedsteads, planks on iron trestles.

Cooking properly done; varied as much as possible.

Attendance.—European hospital serjeant, ward coolies; no nurses.

Sanitary state of European hospitals "good;" no epidemic.

Convalescents.—No convalescent ward; no provision for exercise.

Female hospital.—None; sick wives and children treated in quarters; sanitarium for females at Steamer Point.

Diet and Cooking.

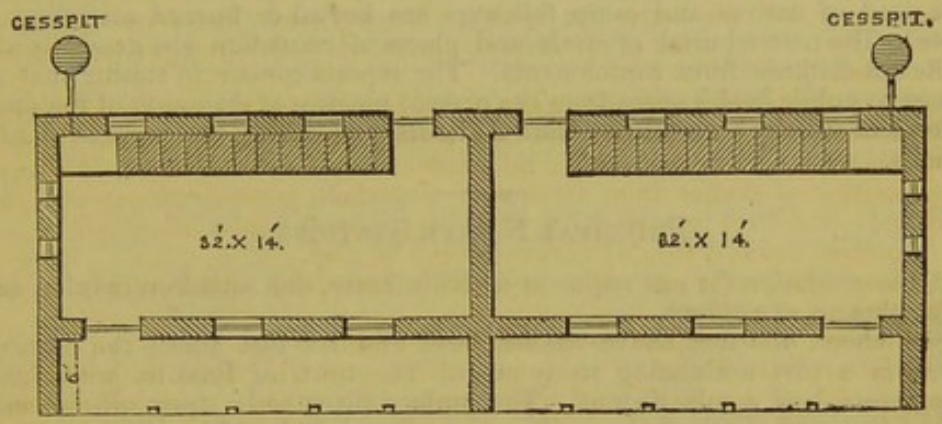
At all the European stations of the Bombay Presidency a complete ration is issued as follows:—Bread, 1 lb.; meat, 1 lb.; rice, 4 oz.; sugar, 2½ oz.; tea, ⅘ oz., or coffee, 1⅗ oz.; salt, 1 oz.; vegetables, 1 lb.; firewood, 3 lbs. The stoppage is 3 annas 4 pice daily (about 5*d.*), which is the sum a married soldier receives if he does not draw his ration. Beef is the usual meat ration, but where good mutton can be obtained it is served out twice a week. The vege-

tables vary with the station and season. The supply of potatoes is in general too limited; sometimes they cannot be had. Cauliflowers, cabbage, and pumpkins constitute the ordinary vegetables; a small quantity of onions sometimes issued. Ration considered excellent as to quality, and is regularly inspected; but no change in the constituents is made to suit climates and seasons. Soldier is allowed to add additional meat and other things, often of very inferior quality. He has three meals a day, breakfast, 7 to 8 a.m.; dinner, 1 p.m.; tea, 5 p.m.; has often meat at all three, or fish and eggs at breakfast and meat at the other two, and this in the hottest hours of the day.

Kitchens generally small outhouses, with native fire-places and native utensils; no chimnies; lighting and ventilation often defective; no water supply; all water has to be carried by hand; no drainage, refuse water either escaping into cesspits or sinking into subsoil. Cooking by native cooks; meat is boiled, fried, stewed, and made into various messes; not always very wholesome. Cooking seldom complained of, but might be improved, both as regards apparatus, economy, and the results. The use of tea or coffee before a march varies in different regiments, in some being given, in others not.

Fig. 13, showing a plan and section of the cook rooms at Kolapore, will give a good general idea of the nature of the barrack kitchens and their drainage.

FIG. 13.—PLAN OF THE COOK ROOMS, KOLAPORE.



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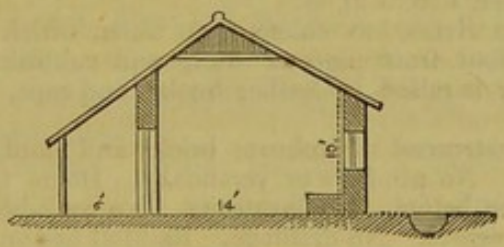


DRESS. Besides the usual cloth and woollen dress, the soldier is provided with light khakee tunics and trowsers, and a head dress to keep out the sun; it is said to be well suited to the climate and duties.

DUTIES. With four exceptions, the replies from European stations advise that recruits should be thoroughly drilled at home before being sent to India; one of these four recommends that recruits should be drilled in a cool climate in India. Stational duties consist of drills morning and evening, generally before sunrise and about sunset, from half an hour to an hour or more, according to season and weather; the number of nights in bed depends on the strength, and appears to vary from four to seven successively; guards last 24 hours, and are mounted at distances off from a few yards to two miles. Except at one station, night duties are not observed to have any injurious influence on health; the number of roll calls varies in different regiments from two to seven; night roll calls are not unfrequent.

PERIOD OF SERVICE IN INDIA. In most of the reports it is recommended that the soldier shall not proceed to India under 20 years of age. The lowest age given in one report is 18, and the highest 27. Fully drilled soldiers at from 20 to 22 years would best suit

the requirements of India, as stated by the reporters. The length of service, they consider, should not exceed 10 years. In one instance, seven years are reckoned sufficient; in another, as many as 15 not too much. The Hyderabad Committee state that "a British soldier may serve as long in India as in any "other part of the world. Two-thirds of the Indian stations are as healthy as "any in Europe, provided the habits be adapted to the country." The stational reports concur as to the desirableness of the soldier arriving in India at the beginning of the cool season, and of his being sent at once to his regiment, great care being exercised to keep him from excess on landing. Invalids should leave for England so as to arrive in early summer.

RISON CELLS. At three or four stations the cells are well situated, have sufficient space and ventilation, and are said to be "healthy." At all the others the sites are more or less unhealthy, the cubic contents too small for the climate, the ventilation insufficient, as also the means of discipline. Many of this latter class of cells are "bad," or "very bad." At Bombay the military prison is part of a native gaol, situated in an unhealthy locality, and badly ventilated. The prisoners are subject to outbreaks of dysentery and cholera.

URIAL OF THE DEAD. All the stations have European burial grounds, in which burial is conducted much as at home. These grounds have generally sufficient area; they are not too near cantonments, and are tolerably well kept. The grave space and depth vary, and are under no regulation. Sometimes the graves are too shallow. The dead of natives and camp followers are buried or burned according to caste. The native burial grounds and places of cremation are generally at a sufficient distance from cantonments. The reports concur in stating that no injury to public health arises from the present practice of disposing of the dead. Interment usually takes place within 24 hours, and during epidemics at shorter periods.

PRINCIPAL NATIVE STATIONS.

Rajcote. Accommodation for one regiment native infantry, one squadron cavalry, and a detachment of artillery.

Site about 450 feet above the sea level, and 100 feet above the country, which is a vast undulating stony plain. The town of Rajcote, with 7,000 inhabitants, half a mile distant. The surface black soil; stony subsoil, with underlying sandstone and trap. Climate on the whole healthy. Highest mean maximum temperature 99°·1 in May. Lowest mean minimum 58°·7 in January. Mean daily range from 4°·8 to 21°·3.

Water supply from rivers, but chiefly from wells, which unless constantly used become very foul from pigeons' dung and rubbish from their nests. No analysis. Water is raised by leather bucket and rope, and distributed by bullocks.

The huts are constructed of unburnt bricks and mud, roofed with tiles. Dimensions various. No windows or verandahs. Doors the only ventilators. Ventilation might be better. No lavatories. No cook-houses. No latrines. Filth removed by sweepers. No drainage. Rainfall lies on the black soil.

Bazaar drained into a nullah. No artificial drainage. Ventilation indifferent. Water supply "good." Great want of cleanliness. No latrines. Bazaar overcrowded.

Prevailing disease among native population, intermittent fever. Skin diseases not uncommon. Cholera occasional. Healthiness of population attributable to fine climate; sickness, when prevalent, to filth of houses and streets, and entire want of ventilation.

Among native troops there have been five cases of scorbutus in two years. No liver disease. Venereal disease has formed 2·9 per cent. of admissions. Prevailing diseases, ephemeral and intermittent fever, yielding together 67 per cent. of the admissions and 26·6 per cent. of the deaths. Rheumatism. Dysentery, rare. Neither cholera nor small-pox. Fevers occur in the transition from wet to dry weather. Health of the troops might be improved if Government rations were issued, as they hoard their pay and do not procure sufficient food. Ventilation of huts is also required. Native troops temperate. No admissions directly or indirectly from intemperance. No means of instruction or recreation, except a library and *gymkhana*, supported by European officers.

Rajcote.

There are two hospitals, with one ward in each. No limitation as to number of beds. Sites healthy. Water abundant. No drainage. Materials: sandstone and chunam. Verandahs. Floors 18 inches above the ground. Ventilation by opposite doors and windows, sufficient when wards are not crowded. Privy 17 yards from hospital, cleaned out every morning. No lavatory. Tepid baths available. Wooden cots; iron better. No kitchens or diet tables. One hospital orderly, with servants. Comrades allowed when necessary. Native women will scarcely submit to any medical treatment. But sick children are frequently brought to the medical officer.

Seroor.

Accommodation for 400 irregular cavalry, 25 native commissioned and 32 non-commissioned officers.

The station is 1,752 feet above the sea, and on the level of the adjacent country, open and exposed to winds, the most prevalent of which is the sea breeze.

Town of Seroor, with 7,000 inhabitants, contiguous to the lines.

Subsoil trap rock.

Climate dry except during monsoon. Influence on health favourable.

Highest mean maximum temperature, 107° F. in April. Lowest mean minimum 50° F. in December and January.

Water supply unlimited, from the river Goar. Water hard, but very good. No analysis.

There are no barracks, only huts. Principal streets of bazaar kept clean, but the native houses generally exhibit carelessness and negligence as to repair. Fever is usually prevalent among the native population after the monsoon. Cholera and small-pox the most frequent epidemics. The comparative healthiness of Seroor is due to open situation and absence of sources of malaria.

Among the troops intermittent fever is prevalent. Cholera is epidemic in the hot season. There is a little mild dysentery. Chronic rheumatism is the chief cause of admission into hospital during the cold months. 27 per cent. of the admissions and 18 per cent. of the deaths are due to fever. 4 per cent. of the admissions and 20 per cent. of the deaths are due to cholera. No admissions to hospital from intemperance. No case of drunkenness on record. There are six or eight cases of venereal disease in the year.

The hospital is a detached bungalow on an open freely ventilated site. Water from wells. No drainage. Impurities removed by sweepers. The hospital is built of burnt bricks. It is on one floor, with a verandah 6 feet wide. Ventilation by open doors and windows. No lavatories or means of bathing.

Dhoolia.

Station in a valley 1,000 feet above the level of the sea. Partially cultivated. Black soil with moorum subsoil.

Climate hot and muggy. Seems beneficial to health of native troops. Highest mean maximum, 101°·39 F. in May. Lowest mean minimum, 60°·7 in December. Mean sun temperature as high as 115° F. in May.

Water supply from rivers and wells. Abundant. Colour, "rather blue." Soft and of good quality.

Accommodation consists of 372 native huts and pendalls (open sheds). Men place their bedding on the ground. Materials, burnt brick. Roof, double tiled. Floors of moorum. Pendalls should have ventilators in the roof. No lavatories nor cook-houses. No privies nor urinals. No drainage. Cleansing efficiently done by sweepers; the refuse used for brick-making.

Bazaar clean; not crowded.

Most prevalent diseases at station, fevers, cholera, and spleen disease. Population said to be "healthy" from pure air and good water. *Diseases of native troops:* liver, very insignificant; sick from venereal, 1 in 40. Most common disease, quotidian fever. Fevers occasion about 55 per cent. of the total admissions. Cholera occurs every hot season.

Troops temperate. No confirmed drunkards.

No means of instruction, except regimental schools. No means of recreation. Troops amuse themselves with quoits and skittles. Not restricted to barracks, either for sun or rain. Native troops should be instructed in field works, road making, making their own clothes, boots, &c., building huts.

Dhoolia.

Hospital consists of one centre room, with a verandah; 12 beds; about 925 cubic feet per bed. Verandah will hold 20. Verandah beds would have about 185 cubic feet per bed. Accommodation too small. No means of ventilation but doors and windows. No drainage. Privies cleansed daily. No lavatories or baths. Common wooden bedsteads. Sepoys bring their own bedding, including two clean sheets. Cooking in an open shed. Attendants, a hospital orderly, a comrade to nurse when required.

Dapoolee.

Site in a hilly country, between the western coast and the ghauts. Dry during the monsoon, swampy in rains. 600 feet above the sea level. Sea, nine miles west. Soil, volcanic; laterite, decomposed trap.

Climate consists of three seasons. Cold, December to February; hot, March to June; rainy, June to October. Rheumatism and chest affections prevail in the rains.

Water derived from wells. Amount varies with the season. There are 77 wells for a population of 3,425.

Accommodation consists of 358 huts, one per man. They are 18 feet long, 8 feet broad, and 10 feet high. They have a door and opening opposite for ventilation. Size too small for families; and they are overcrowded.

No sewerage. Dampness pervades every building during the monsoon. No lavatories. Cleansing tolerable.

Bazaar has only surface drainage to the nullahs. Water tolerably plentiful. Five labourers employed for cleansing. Dung or dirt heaps are common. Crowding considerable. Among the native population little disease in hot and cold seasons. In rainy season diarrhœa, dysentery, and chest complaints; cholera, choleraic diarrhœa, measles, small-pox occur at intervals. Fever "attributed to insufficient food, exposure, and hard labour." Cholera, measles, and small-pox, "to unripe fruit, contagion, and unknown causes, chiefly atmo-
" spheric."

Among the troops there is very little hepatic disease; no syphilis; quotidian intermittent occasions about 28 per cent. of the admissions, and rheumatism about 11 per cent.

The sepoys are temperate. No confirmed drunkards.

There is a native school, but no other means of instruction. No means of recreation, except plenty of shade.

Hospital on a good site; supplied with well water from two wells in the compound. No drainage. On one floor; no ventilation beneath the floor, which is composed of hard beaten earth, "cow-dunged every week." There are two wards containing 30 beds each, at 1,250 cubic feet per bed. Materials, laterite stone, with lime plaster. A verandah 8 feet wide. No means of ventilation except the windows. Wards cleansed once a quarter. Privies are 75 feet from hospital. No drainage nor water. Cleansed by sweepers. No lavatory. There is a bath room, with means of heating water, for each ward, but never used for native sick. Their usual way of bathing is to throw hot or cold water over themselves. Bedsteads of wood, infested with bugs. Iron ones should be introduced. Native sick use their own bedding. Two cook-rooms for castes to each wing. No apparatus. The sick either cook for themselves or a Brahmin cook does so. Attendance by an orderly from the corps, and a comrade when required.

Jacobabad.

There is at this station accommodation for 2,400 native cavalry, and 1,600 native infantry.

It has an elevation of 220 feet above the sea.

The surrounding country is desert, flat, sandy, and dry.

Climate said to be the driest in the world. The highest rainfall in any year since 1851 has been 8 inches; the lowest 2½ inches. Summer heat excessive. Mean temperature from April till end of October varies from 80° to 99° F. The variation is very great, and the climate "totally unfit for European
" soldiers."

Water is brought in canals from the Indus, 52 miles distant, and stored in tanks. There are wells supplied by soakage of this water. It is raised by the Persian wheel and buckets. It is yellow at first, but becomes clear on standing. Amount sufficient. Quality not injurious to health.

Jacobabad.

Bazaar kept "scrupulously clean." Country thinly populated. Prevailing country fevers: intermittent, quotidian, tertian, complicated in winter and spring with chest diseases; diarrhœa and dysentery; spleen disease common; chronic rheumatism frequent.

Among the troops there is little hepatic disease. Annual proportion of admissions from syphilis less than 15 per 1,000 of admissions. Endemic fever the chief disease. Dysentery not very frequent. Cholera unknown. Only one apparently sporadic case in six years. Small-pox rare. Chronic rheumatism and neuralgia "common."

Troops accommodated in pendalls, which give 612 cubic feet and 72 square feet per man. No windows. Each man has his own door. Men sleep out altogether in the hot weather and inside in the cold.

No lavatories; natives wash in the open air, with the aid of bheesties. No cook-houses. Each man has his own cooking arrangements. No privies or urinals. No drainage.

Hospital on one floor, built of brick and mud. Verandah all round. Hospital "used more as a dispensary, only the worst cases requiring constant "attendance being kept in it; these are placed wherever it is coolest." Ventilation said to be "good." Water supply from the same source as in barracks. No drainage. Refuse water and other impurities removed by sweepers. No privies. No kitchen. Men "make their own arrangements "for cooking." Men "supply their own bedsteads and bedding." No attendance. "When there are bad cases, the patient is allowed to have a comrade." No sanitary defects "to remark upon or improvements to suggest."

Dharwar.

Accommodation for 900 native infantry.

Station 2,482 feet above the sea. Country, barren hills; undulating. Said to be one of the healthiest stations in the Bombay Presidency. Climate very good; not very hot; never very cold; occasionally foggy; equable. Geological formation, metamorphic clays, mica schists, &c.

Water derived from wells and tanks; said to be "very good and wholesome;" but said "to give rise to guinea worm among the natives." Amount generally sufficient for drinking and cooking, but scanty for other purposes in hot weather.

The bazaar is crowded and narrow, with very imperfect ventilation. Said to be clean.

Prevailing diseases among natives are fevers, bowel complaints, rheumatism, guinea worm, cholera "*every now and then*;" scarcely any spleen disease.

There are no barracks. Liver disease very rare among native troops. About 8 per cent. of the cases of sickness are guinea worm, supposed to arise from the water. Venereal cases about 8 per cent. Intermittent fever is the most prevalent disease. There are a few cases of mild remittent; very little dysentery. But there is cholera in its most virulent form, and chronic rheumatism is common. Above 77 per cent. of the deaths have been due to cholera, and 4½ per cent. to dysentery. But the total mortality is small.

Hospitals, one floor buildings, with verandahs. Ventilation not very good in permanent hospital. Ridge ventilation in temporary hospital answers admirably. Contents of privies removed daily.

ADDENDA.

Extracts from Papers relating to the Sanitary Management of European Troops in the East Indies, by T. E. Dempster, Deputy Inspector-General of Hospitals.

Use of hill climates.

Much has been said and written regarding the effects of the hill climate on the European constitution, and on the class of invalids likely to benefit by a residence at the hill sanitary depôts. All I have seen leads me to sum up the whole question in a very few words, viz., sound European adults, if moderately careful, retain their health and vigour unimpaired at good hill stations; and children, the offspring of pure European parents, are there as joyous, rosy, and active as in any part of Europe. The young and naturally robust, although reduced by recent illness, and provided they do not labour under serious organic disease, generally recover rapidly and completely in the hills. Slight and recent cases of organic disease, especially if the spleen is the organ affected, often do well; but they require very careful management and a residence of two or more seasons at the sanitary depôts. On the other hand the old and worn out, the afflicted with organic disease of long standing, and those whose constitutions have been seriously impaired by long exposure to a high temperature, instead of deriving benefit will generally find their complaints aggravated by removal to the hills. Such, I believe, to be the general rules which should guide our selection of cases to be sent to the hill stations, to which doubtless there may be some especial exceptions. *Diarrhœa* is the endemic of these elevated regions, but assuredly it was not prevalent at Landour the year I had medical charge of that convalescent depôt. The quality of the water of the hill springs and streams may have something to answer for, but I am inclined to believe that the well known cause of this complaint everywhere, viz., *suppressed perspiration*, is really principally to blame. Most of the European residents have previously had their vital energies reduced by disease or exposure to a high temperature; and on their arrival in the hills they are very liable to have their morbidly sensitive bodies *first over heated, and then suddenly chilled*, under the circumstances set forth above. The grand prophylactic I conceive to be flannel, and especially the broad flannel abdominal binder, worn next the skin. If this should really turn out to be the common cause of bowel complaints at our present hill stations, the risk would be greatly reduced by keeping the men in well chosen localities at a lower elevation; but then certain classes of invalids would lose the curative effects of the cool bracing air of the upper regions.

European regiments which had previously suffered severely at unhealthy stations in the plains are well known to have lost great numbers of men on being transferred to the hills. I think Her Majesty's 13th and 29th regiments of foot will be found to have furnished striking instances of this nature. I am of opinion that it would have been more judicious to have sent such sickly corps to a healthy locality in the north-west provinces,—such as Meerut,—where there is good barrack accommodation, and ample supplies of excellent meat, bread, fruit, and vegetables.

The following precautions are recommended to be observed by all invalids from the plains proceeding to the more elevated hill convalescent depôts,—such as Landour and Darjeeling. The ascent should be made in a slow and gradual manner, and the patient should be provided with an ample supply of warm clothing,—including flannel shirt and abdominal binder,—to put on as he comes into the upper and colder regions. If the invalid is much reduced in strength, and especially if he is labouring under disease of internal organs, the whole ascent should not be accomplished at once; but he should remain for a

day or two at some convenient mean elevation, where proper shelter should be provided for the sick. It is at such half-way house that a complete change of clothing should be made before ascending to the highest point. Invalids often perform the whole journey from Rajpore, at the foot of the hills north of Deyrah, to the depôt hospital at Landour (about 7,600 feet above the level of the ocean), *in less than four hours!* In this short space of time they exchange the heat of the plains of India for an almost European climate, and a greatly reduced atmospheric pressure. That the robust and healthy human frame should be able immediately to accommodate itself to such entirely new conditions, without injury to its delicate and complex organism, is surely one of the wonders of nature. But when the body is enfeebled by sickness, and vital organs in a state of actual disease, this sudden plunge into a cold and rare atmosphere is too apt to chill the surface, disturb the balance of circulation, and cause congestion of weak internal organs. Nor is it surprising that serious derangement, or even fatal mischief, should occasionally result from such an ordeal.

The same general precautions should be observed by corps ascending the hills, more especially that one which relates to a proper change of clothing on attaining a certain altitude. I am persuaded that not a little of the blame that has been cast on the hill climate is fairly to be ascribed to a neglect of the above obvious and reasonable precautions.

Effect of locality on health.

Of all the deaths of European soldiers which I have witnessed in India, the great majority have occurred from diseases of undoubted malarious origin and their sequelæ. The first and most indispensable rule, therefore, for preserving the health of the British soldier in the plains, must ever be to place him in as good and healthy a locality as possible. And I would here especially direct attention to the fact, that there are few districts in the north-west and central provinces of Bengal which are either wholly good or wholly bad; that in almost every district unhealthy and comparatively healthy localities exist; and that unhappily we have too often chosen the *former* as a site for our European cantonments. This I believe to be especially true with respect to Cawnpore, Kurnaul, Dinapore, Delhi, Ghazeepore, &c. Nearly all these stations are irremediably vicious, and yet I believe good localities exist at no great distance from every one of them. The *close proximity* of some of the worst and some of the best localities, examined by the Canal Sanitary Committee, was one of the most curious and important facts elicited by that inquiry.

Means of ablution.

A good plunge or swimming bath is a troublesome and expensive affair, and as it can only be used with safety by the most healthy, vigorous, and temperate of the men, I am inclined to dispense with it altogether. The ordinary Indian "douche" or *affusion bath* is comparatively safe, while it is, at the same time, simple and easily managed in the extreme. A number of water-pots of convenient size, and made of the very cheap country porous earthenware, are placed on a bench, or on the floor of the bathing room or tent. If a cold bath is to be used, the porous water-pots are filled the night before; if a temperate bath is desired, the pots are filled just before being used. Tepid affusion is easily managed by adding the necessary quantity of hot water. But, in general, the pot of cold or temperate water is lifted up by the bather himself, and emptied over his head and naked body, a second, third, or fourth pot following in rapid succession. The body is then quickly dried and vigorously rubbed with coarse cotton towels; reaction speedily follows; and a safe, refreshing, and invigorating bath is completed.

During the *hot* season in the plains, such a bath as that above described,—if superintended by an intelligent non-commissioned officer,—may be used with comfort and benefit, under ordinary circumstances, by a majority of the men. I have given the above details to show how cheap and simple are the means, and how easily the arrangements can be made wherever there is a good well and a supply of earthenware water-pots, that is to say, in almost every inhabited part of the country. A spare tent can always be turned into a convenient enough bathing room in camp. The weak and sickly, the afflicted with organic disease of any kind, and the confirmed drunkard, must, of course, avoid cold affusion altogether. Still, they too should observe personal cleanliness, and wash parts of the body cautiously and in succession with tepid water.

The condition of all such persons ought to be fully known to the medical officers of the regiment, who can, without much additional trouble, at the regular medical inspections, class the men for the different kinds of ablutions. Very simple and efficient arrangements can also be made to enable all to wash the feet, nates, and genitals, in cold or tepid water. Whatever is really conducive to strict personal cleanliness in a hot climate can never be deemed trifling or unimportant, therefore I have no hesitation in here recommending for general adoption in the barracks, a decent and salutary custom, borrowed from the natives of India, and universally practised by all Anglo-Indians of the upper classes, viz., to wash with pure water whenever the bowels are moved. Arrangements for conveniently doing this are of the simplest possible nature.

Food and drink.

The English are notorious for adhering to their national customs and modes of life in all parts of the globe. When I visited the Mauritius in 1832, it was generally understood that the English residents, including the garrison, were then suffering much from various forms of tropical disease, while the French and Creole inhabitants of the island were comparatively healthy. The English, it was said, ate, drank, slept, and walked abroad pretty much as they had been accustomed to do at home; but the French and Creoles, on the other hand, rose early for out-door work or exercise, partook sparingly of concentrated foods and stimulant drinks, and in other respects adopted habits more suited to the tropical climate in which they were living. Such was the story told, and the explanation given of it, on the spot; but whether strictly true or not, it unquestionably points to a sanitary truth of grave import. I do not mean to assert that the Englishman in India should live precisely as the native of the country does, for the conditions are not the same, each differing from the other in race, inherited temperament, and acquired habits; but without pinning my faith to all the modern chemical theories of alimentary substances, I do maintain that both instinct and wide experience teach that the former cannot, with safety, either eat or drink in India as he did in England, and that the same quantity of animal food and stimulant drinks, taken with advantage by a *working* man in a cold moist climate, is not only unnecessary, but positively injurious to the *almost idle* European soldier in the burning plains of Hindostan. Of the recruits drawn from Ireland and Scotland, it is certain that the majority must eat in the hot weather in India *many times the bulk of animal food* ever consumed in their native country while working hardest in the coldest season of the year. The same, however, cannot perhaps be said of the consumption of ardent spirits.

The raw materials supplied by the commissariat as food for the troops in India have been greatly improved of late years, and especially since the promulgation of Lord Dalhousie's orders on this subject. Not only are the beef, mutton, and bread of better quality, but a liberal supply of the vegetables of the season has been added to the soldier's ration. The power to reject inferior or unwholesome articles of food now rests entirely with the officers of European regiments. It was not so in former times. The present scale of barrack diet is ample, and not improper for men using active exercise in the cold weather; but I am strongly impressed that too large a quantity of *concentrated "nitrogenous"* aliment is consumed by men confined to an up-country barrack, and leading a life of monotonous inaction, during the long dreary months of the hot and rainy seasons in the plains. A good *barrack dietary* for *the hot season* is still, I think, a great desideratum; and I am persuaded that there is always to be found abundant material, if properly dressed, to furnish such a variety of wholesome, palatable, but *not too nutritious* food, as would render it easy considerably to reduce the allowance of solid beef and mutton, without trenching on the real comfort of the men. Of good food there is now no deficiency, but a good wholesome system of cookery is still a great want. The soup and boiled beef have long disappeared from the mess tables of the Company's European troops, and their daily bill of fare presents a sufficient variety of dishes; but the cookery is generally of a very objectionable character, all meat being made into rich pies, or hot curries, or fried with fat in common frying pans. Beyond this, their barrack culinary art does not at present go. While on the subject of food, I must not neglect to warn all concerned against the use of the flesh of the *common village swine*. The natives of India, as the Israelites

of old, go beyond the camp to relieve the calls of nature, but they do not observe the salutary Mosaic injunction, to have a paddle on their weapon and "turn back and cover that which cometh from them." The ground so defiled is generally quickly cleared by herds of swine, literally fed upon human ordure, which they devour with surprising greediness. The men of newly arrived European regiments, if not duly cautioned, are often delighted to find both *pork* and *bacon* so abundant and cheap everywhere; and much to the horror of the high caste Hindoos and Mussulmans, and not a little to the scandal of the old Anglo-Indian, a number of these disgusting country pigs have sometimes been permitted to follow in the rear of a British regiment as part of its "flocks and herds." I need not say that all such "*ordure fed*" pork and bacon should be strictly interdicted as unwholesome in the highest degree. Such food is looked upon by old European residents with as much disgust as by the Jews or Mussulmans. Strange to say, the Indian *sheep* too, if not watched and properly fed, is scarcely more cleanly in this respect than the pig; and it becomes necessary to ascertain that sheep killed for the use of the men have been well and properly nurtured.

Use of ardent spirits.

This is a subject on which I have long looked with deep and painful interest. I have lived too long with European troops in India not fully to coincide with Dr. J. Johnston and Sir Ranald Martin when they say, "that as drunkenness "leads in a moral point of view to every crime, so in a physical point of view "it promotes the invasion, and retards the cure of every tropical or other "disease." In this sense, the abuse of ardent spirits has been the fertile source of a large amount of the moral and physical degradation I have witnessed among my countrymen in the East. Fully persuaded of this, I considered it my duty, so long ago as 1836, at Agra, to endeavour to establish a society among the men of the 4th battalion of artillery, the members of which pledged themselves to abstain altogether from the use of spirits in any shape; a fair number joined, and for a time it seemed to promise well; but the officers of the corps looked coldly on, and the scheme, after a trial, fell to the ground. Years afterwards a temperance movement was renewed at Meerut, in the 1st brigade horse artillery, and this time the officers were its chief promoters. The detestable *morning dram* was abolished altogether, and no spirits allowed until *after dinner*. This was a great step in the right direction, for I have never known either officer or man who *could not dispense* with a dram of raw spirits when he got up, who did not go to bed drunk, if he had the means of doing so. The men were encouraged to receive a money compensation in lieu of spirit rations, or to drink a certain quantity of good ale or porter instead of rum. After a time I learnt that only 20 men of Major Dawe's troop (2nd troop, 1st brigade, horse artillery) drew spirit rations, and that all the rest either drank a moderate quantity of ale, or abstained from stimulants altogether. The effect of all this on the health, efficiency, and good conduct of the men was excellent. I had never before seen European troops in India in so good a condition in all respects. This troop had arrived from the sickly station of Loodiana with 50 per cent. actually in hospital; and after a residence of nearly four years at Meerut, where the above-mentioned reformation took place, they marched to Sealkote *with a clean bill of health;* no death having occurred among the men for a period of two years. I have no records to refer to at present, but the above is, I believe, substantially a true and faithful statement of what then took place. In congratulating ourselves on the results of this temperance movement, however, it is but fair to state that Meerut is one of our most healthy localities.

Although I am of opinion that the freshly arrived European does best to confine himself to pure cold water or slightly acidulated drinks, yet if good malt liquor is only to be considered a substitute for rum, I would advocate its use from the very first. After several years' residence in India, good pale ale is often drank with advantage; and to the weak anæmic female in India, it is often one of the real necessaries of life. My testimony on this point may be of more value from the consideration that I have no personal predilection for malt liquor, having never been able to drink it in my life. Beer or ale is however an expensive and bulky article to carry, as compared with spirits. Great care and attention is also required in transporting it up country, large quantities having become bad and undrinkable on reaching the commissariat stores

at Meerut by the old modes of conveyance. But *railroads* should now be able mainly to obviate this objection to supply the troops with ale or porter instead of *rum*.

Clothing.

If the European is out in the open air before sunrise in the cold season of the upper provinces, he will experience the *sensation of cold* even more acutely than he ever did at home in ordinary winter weather, and will confess that good warm clothing is at least equally necessary in both situations. The temperature of the early morning air is not very low, it is true, as measured by the thermometer, probably from 36° to 40°; and occasionally it touches the freezing point; but the heat in a tent at 2 p.m. of the same day will often be found from 70° to 80°. Even in the cold season it is found necessary to begin a march before sunrise, so as to reach the new ground before the sun is very high; and this extensive diurnal range renders the European system morbidly sensitive to the morning cold. I say the *European* system, for it has often excited my wonder on a march to see robust horse artillerymen dismount from their horses at the first halt benumbed with cold, and running up and down to restore the circulation in their extremities, while half naked native children were playing about as if nothing unusual were the matter; but if a good supply of warm clothing is necessary in the cold, light cotton garments are equally indispensable in the hot, dry, and rainy seasons. And here I would especially urge the necessity, *at such seasons*, of keeping the soldier's *neck* in every situation as free and unincumbered as the neck of the British sailor is at all times. Nothing so much interferes with the comfort and free action of the whole body as any warm, tight, or stiff covering round the neck. Who has not experienced the relief of removing a hot neckcloth, and opening the shirt collar after being overheated? A turnover collar loosely tied with a narrow black band is surely as graceful and seemly as any military stock ever invented.

If the robust and healthy European has never worn flannel at home, he may continue to dispense with it on his first arrival in India. But after a residence of a few years, when the system has been lowered and rendered sensitive to all atmospheric changes, a good *light* flannel shirt worn next the skin is unquestionably an excellent safeguard against contingent evil. A proper fabric of this kind is procurable by the more wealthy classes; but I have never seen any flannel served out to the soldier in India that his officer could be induced to bear next his own skin in really hot weather. This is a point which I am sure calls for attention and remedy.

Exercise and amusement.

The question is often asked, should the European soldier be strictly confined within the walls of his barrack during the heat of the day in the warm weather, or may he be permitted occasionally to walk abroad, as in other and more temperate climates? The alternative will be found a perplexing one. If you confine him to his barrack room, how is the uneducated man to get through the long dreary day? The officer has walked or ridden out in the early morning; on his return home he has looked in at "the coffee-shop" or reading room, and has seen and conversed with persons not always before his eyes. During the day he visits his friends, spends some time at the billiard room, or more profitably employs his time in reading, or other intellectual amusements at home. But the uneducated soldier, shut up in his barrack, has literally nothing to do but to lie down and try to sleep, until the hour shall come for dinner, and the long-looked-for *dram* to relieve, for a short period, his utter vacuity of mind and lassitude of body. Rather than force men to lead such a life, is it not better, say many well-informed persons, to give the soldier a reasonable indulgence to walk abroad, even in the heat of the day, not buttoned up to the throat and in red regimental jackets as some martinets will have it, but in loose white cotton clothes, open collars, and proper white covers to their caps. But *where* are the men to go? They have no acquaintances to visit, few out-door amusements to join; and it is too likely they will find their way to the nearest bazaar, and add the dangers of intoxication and other debauchery to that of a fierce tropical sun.

Causes of Loodiana fever.

The old cantonment of Loodiana was built along the margin of the high ground overlooking an extensive tract of low, moist land, which formed the ancient bed of the Sutlej. Water flowed in a pretty strong stream all the year through, by a water-course which served to drain not only the cantonment

itself, but the low ground immediately under it. The surrounding country is studded with elevations of fine loose sand, which is driven before the strong dry wind in the hot season. Much of this sand found its way into the watercourse, but, under ordinary circumstances, the force of the current was sufficient to keep its channel clear and prevent its being choked up. The periodical rains are most irregular and precarious in this part of the country. The first year at Loodiana a fair quantity of rain fell; the watercourse above alluded to flowed continuously and with a rapid stream, and the season proved healthy. Next year a few showers only fell during the expected rainy season; the watercourse became dry, and its channel completely choked up and obliterated with drift-sand. But this year also proved remarkably healthly. The *third* year much rain fell at the usual season, but the water, no longer finding an outlet through its usual channel, spread itself over a large surface of the neighbouring low ground, where it formed extensive shallow stagnant pools. For some time after the breaking up of the rains the station continued healthy, but in the first week of October, almost every inhabitant of the place was prostrated with fever. Next year an attempt was made to clear the watercourse, by letting in from above a small stream of the Sutlej, as that river rose in the rainy season; but the scheme failed, and perhaps did more harm than good. The *fourth* season was quite as bad as the third, and the men of the first brigade horse artillery marched, in the ensuing cold weather, towards Meerut, prostrated by disease, and having 50 per cent. actually in hospital.

There are some points deserving of particular attention connected with these almost universal invasions of endemic fever.

1st. The type of the disease was very virulent, and a patient not immediately seen, and judiciously treated, ran great risk of dying in the cold stage.

2nd. The men of the horse artillery, all picked men from the whole body of artillery recruits, were, at that time, lodged in one of the best and most commodious barracks then built in those provinces, yet they suffered far more severely than the European foot artillerymen, a decidedly inferior class in all respects, and who occupied a barrack of the oldest and most objectionable construction. The explanation I conceive to be as follows. Between the horse artillery barrack and low ground (the true source of the malarious poison) there was no effectual screen of trees or houses interposed; while, betwixt the foot artillery barrack and low ground there were not only more trees, but a considerable *smoky* native bazaar.

3rd. After a year's residence at Meerut I particularly remarked the curious fact, that the Loodiana fever hung more obstinately to the officers and their families than to the men and women of the corps generally; and this, I believe, may be accounted for by the consideration that the former had lived in bungalows close to the verge of the high land, and had probably received a more concentrated dose of the marsh poison.

The whole circumstances of the case above related appear to me strikingly to illustrate the conditions under which malaria is eliminated in the N.W. provinces of India, and farther to demonstrate the danger of locating troops either on the banks of large up-country rivers or on the margin of the low moist tracts of land which once served as the beds of such rivers.

Climate of Bengal proper.

The climate of Bengal proper differs in many important respects from that of the upper provinces, being much less hot in the hot weather, and much less cold in the cold. At the hottest season of the year in the lower provinces the air is comparatively cool and moist, and the face of the country green, and generally characterized by a luxuriant tropical vegetation. Here there are no "hot winds," and "tatties" and "thermantidotes" are consequently all but useless. The periodical rains are far more copious and continued than in the north-west, and the temperature is seldom so low, at any time, as to render a "punkah" disagreeable during the day, or a fire necessary at night. Here too the European can generally manage to sleep at night without being constantly fanned by the punkah. In the latitude of Agra, Delhi, Kurnaul, &c., a fierce dry hot wind blows during the day from about the 10th of April until the latter end of June. At some places, as at Cawnpore, the hot wind continues during a great part of the night. The whole face of the country is at this time parched up and devoid of vegetation. To this succeeds a warm moist rainy season, when the ground, lately so bare and apparently so sterile, becomes covered

with luxuriant green crops within a period so short as to excite the astonishment of the newly arrived European. Although the temperature of the external air is so much greater in the hot winds than in the rains, it is in the latter season that the sensation of heat is most painfully experienced,—still air, loaded with moisture, and at a temperature exceeding 90°, becomes almost intolerable to the European; at such times the only relief is the constant action of the punkah day and night. This rainy season terminates about the end of September, and is followed by October with its cool nights and hot and often oppressive days, the month of the year most fatal to the European constitution. The cold weather often dates from the 1st of November, but after the 15th of that month it has decidedly set in all over the north-west provinces. From the latter date until the end of February the European officer sits with a fire in his apartment, sleeps at night under blankets, and dons, especially in the early morning, apparel as warm and comfortable as he would wear in England. The heating power of the ray of the unclouded sun, however, is often considerable even in the coldest season, and violent exercise in the open air at mid-day irksome and oppressive.

The inhabitants of Bengal proper are a small, effeminate, and unwarlike race; those of the north-west provinces, on the other hand, are comparatively large and robust in frame, and energetic and courageous in character.

Selection of stations.

Points which should be mainly kept in view in selecting a proper position for European troops in the plains are:—

1st. To choose not only a dry, well-drained site for the cantonment, but to take care that such site itself is situated in a generally well-drained country, free from swamp and shallow pools, and not subject to inundations of any kind at any season of the year.

2nd. To select, if possible, a light permeable soil, with a good natural surface drainage, and by all means to avoid a stiff retentive clay.

3rd. To avoid the banks of large up-country rivers, and the vicinity of the low moist "Khadir" land, once the bed of these rivers.

4th. To fix on no position until satisfactory evidence is obtained that the native inhabitants of the district have a healthy aspect, and are generally free from marks of having habitually suffered from malarious diseases. Wherever this is the case, it will be almost universally found that the drinking water they use is good and wholesome.

Evils of spirit drinking.

If active service in the field is undertaken in the hot season, it would tend greatly to the health of the men to abstain altogether from stimulants in any shape or form, except on special occasions to be determined by their medical officers. But how British troops would submit to such regimen is another and more uncertain question. Good *tea* and *coffee*, served out early in the morning, and before the commencement of a march, and again during the day and at night, are the substitutes I would propose for stimulant beverages of any kind. I am acquainted with officers, keen sportsmen, who are celebrated for their power of undergoing, with impunity, a great amount of fatigue and exposure to the sun in the hot season, and who never taste spirits or beer while so exposed, but confine their drink entirely to *cold tea*. The sale of bazaar or country spirits is a fertile source of injury to the men and perplexity to their officers; and the clever manner in which both sellers and buyers sometimes contrive to escape detection would be amusing, were it not so mischievous. For instance, when the 1st brigade horse artillery were in camp at Umballa, our men were getting drunk in the most mysterious manner, although every reasonable precaution had been taken to prevent the irregular sale of liquor. Immediately in the rear of our camp was a "tope," or grove of trees, and under this shade was encamped an apparently respectable native traveller, with the female members of his family, in a covered "bylie," or bullock carriage. Around one side of this covered cart was a slight canvas enclosure, the usual arrangement for enabling respectable native women to cook and eat unseen while on a journey. It is rude, and in every way improper, to pry into the interior of such an enclosure or covered vehicle, and for a long time the presumed respectable native traveller remained undisturbed. At last a drunken soldier exposed the whole trick. The covered cart, instead of concealing respectable native females, held a *cask of spirits*, and the enclosure was the place into which the men crept, one by one, to buy and drink the liquors. Country

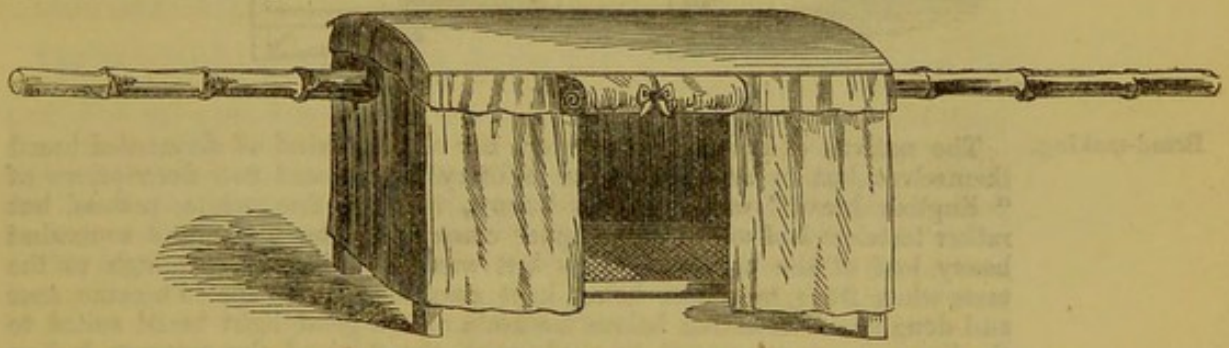
spirit is sometimes adulterated with *datura* to add to its intoxicating power, and I have often seen it produce most serious and occasionally fatal effects.

The single objection I see to altogether prohibiting the distillation and sale of country spirits in all cantonments occupied by European troops is the considerable loss the revenue would suffer in that case. But this is a question solely for the consideration of the Governments.

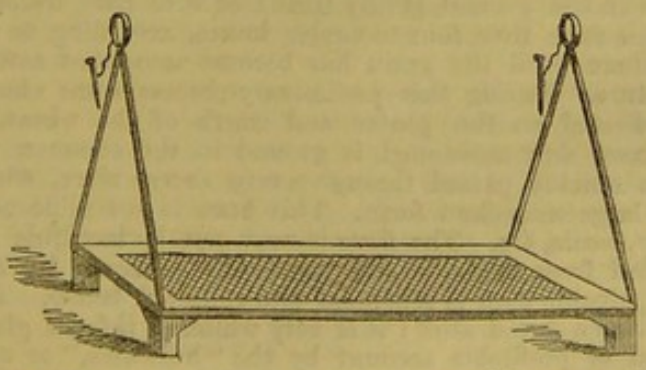
Carriage for the sick and wounded.

During the siege of Mooltan and subsequent Siekh campaign, I had an excellent opportunity of comparing the merits of the Bengal and Bombay army dooly as a conveyance for the sick or wounded soldier in the field. At first sight the Bengal dooly appears a very rude and primitive contrivance, in respect to workmanship, but it will be found to combine the following useful qualities. It is light, and so slung on its bamboo pole as to be easily carried by the bearers. It can be readily converted into a most convenient and comfortable camp bed. It affords greater facilities for putting in, or taking out, a very weak or severely wounded man than any contrivance with which I am acquainted. On the march, the very sick or severely wounded soldier, once comfortably placed in the Bengal dooly, need not be removed from it at all until he reaches his final destination. At the end of a day's march the top and cloth cover are quickly taken off, the dooly and its occupant placed in the hospital tent, and the pole withdrawn before the sides of the tent are laced on, leaving the patient undisturbed in a comfortable camp cot. In the morning, as soon as the walls of the tent are taken down, the pole, top, and cloth cover are again quickly replaced, and the dooly removed from under the tent, and ready to proceed in rear of the marching column, without the smallest fatigue or inconvenience to its tenant. A wounded man can be dressed nearly as easily in his dooly as on an ordinary hospital cot, the only drawback being that the patient is placed a little too low for the surgeon; but this can be remedied by putting a few bricks under each of the short legs. Finally, during very hot, very cold, or rainy weather, the dooly tops can be turned into a convenient shelter for the bearers. On active service, and where bearers are not to be replaced if they fall sick, this is no unimportant consideration.

BENGAL ARMY DOOLY, WITH TOP, BAMBOO POLE, AND CLOTH COVER ADJUSTED.



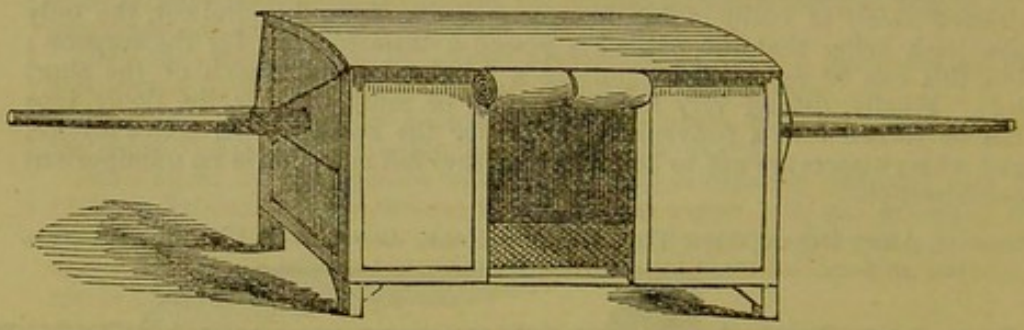
BENGAL ARMY DOOLY, WITH TOP, POLE, AND COVER REMOVED, AND READY TO BE USED AS A CAMP COT.



The Bombay dooly has a cane bottom, immoveable top, and fixed painted canvas sides or panels, and the pole, which is fixed as in an ordinary palan-

queen, cannot be withdrawn; the frame is light, but substantial. When entire and in good order, this kind of dooly affords an excellent shelter for the sick, or for surgical instruments, medicines, and dressings, in very stormy or rainy weather; but here its advantages stop. It is not so easily carried by the bearers as the Bengal dooly, in consequence of the lower point at which the pole is fixed. It cannot be used as a bed for the sick, unless left outside of the hospital tent altogether. A very weak or severely wounded man is placed in it with much difficulty, and being in, cannot be taken out again without inflicting much suffering and fatigue. Moreover, it is hardly possible for a surgeon to dress a severe wound, or perform any operation on a patient lying in such a conveyance. Lastly, the stiff-painted canvas panels are readily torn and injured by stumps of trees and such like obstacles, and when so injured it is for the rest of the march or campaign a less efficient protection against wind or rain than the Bengal dooly, with its loose, not easily torn, but easily repaired cloth curtains. A few inexpensive alterations and additions would render our Bengal dooly everything that can be desired. An additional good cloth to the curtains, or, better still, a dooly cover, entirely made of *white country blanket*, with a sufficient number of proper buttons to close the sides and fix the ends of the curtains in boisterous weather, would render it a complete protection against wind or rain, and so obviate its single defect. On field service, ten doolies, with six bearers each, are (if I remember right) allowed by the regulations for every hundred European soldiers; but on occasions of ordinary relief, only one half that number.

Bombay Army Dooly, as it must remain at all times.



Bread-making.

The natives of India neither make nor use any kind of fermented bread themselves, but in every European military cantonment two descriptions of "English bread" were formerly known, viz., the fine, white, porous, but rather tasteless loaf used by the upper classes, and the brown and somewhat heavy loaf of the barracks. This last was often agreeable enough to the taste when fresh, but after being kept some hours was apt to become sour and doughy. The native bakers maintain that a good light bread suited to the European taste cannot be made with the flour of the common Indian bearded wheat, but that "*soojee*" must invariably be employed.

To prepare the "soojee" for fine bread.—The whole wheat is placed in small separate heaps on the ground, gently sprinkled with pure water, and allowed to remain in this state from four to twelve hours, according to the condition of the atmosphere, until the grain has become somewhat soft and swollen with the moisture. During this preliminary process some chemical change is doubtless effected on the gluten and starch of the wheat. The grain, after having been duly moistened, is ground in the common Indian hand-mill, and then quickly passed through a *very coarse* sieve, which separates the bran in a large unbroken form. This bran is put aside and only used to feed poultry, cattle, &c. The flour is next put by handfuls into *very fine* sieves suspended from the roof and vigorously shaken. By this process a fine, white, impalpable flour is separated and collected below. This fine flour is also rejected as a bread stuff; it is very white, is rich in gluten, but can only be turned to profitable account by the "hulwaees," or native confectioners, to whom it is usually sold. The residue of the flour, after these two siftings, is then subjected to the following curious manipulations, commonly

performed by females :—A woman sits on the ground with a heap of the flour on her right; this she takes up by handfulls and places in a sort of broad shallow shovel made of "sirkee" grass called a "sooph," and, by a very dexterous movement of the hands, she causes all the lighter and darker portions of the flour to fall on the ground immediately in front, while all the more round, solid, white particles are collected at the lower edge of the shovel, and are from time to time transferred to the ground on her left side. When the whole has undergone this manipulation, the heap on her left is the *first* "*soojee*" used in making the fine, white, porous loaf; that in front is called *second* "*soojee*," and of this last material the barrack loaf was entirely formed. If a very fine "soojee" is required, it is subjected to two or more such siftings. This "soojee" is, I believe, identical with the article now sold in England under the name of semola or semoulina. "Toddy," or the fermented juice of the date tree, is the yeast commonly used by the Indian baker, but when that cannot be procured, other, but less efficient, ferments are occasionally employed. It was pretty generally supposed that the old barrack loaf was made of whole or unbolted wheaten flour; but, from the account given above, it will clearly appear what an entirely different thing this second "soojee" is after the abstraction of the bran, fine impalpable flour, and fine "soojee"—all rich in plastic, nutritious principles. The fine "soojee" is rich in gluten, and makes a light, digestible, and nutritious bread; but it may be doubted whether it is really to be preferred, as a barrack ration, to the well-baked brown loaf, made of whole or unbolted English wheat.

Mr. Astell, formerly judge and magistrate of Bolundshuhur, not only succeeded in growing good English wheat at that place, but baked and used in his own family an excellent household bread, made entirely with whole or unbolted English wheat flour. I have often seen and eaten this bread, and found it unexceptionable in all respects.

A good, wholesome, and nutritious barrack loaf is a matter of prime importance to the British soldier in the East.

T. E. D.

LIGHTING of BARRACKS in INDIA, by Lieut.-Colonel OUCHTERLONY.

The irksomeness of military life in the East is more especially felt by the private soldier during that period of the day which intervenes between the setting of the sun—followed as it is by almost instantaneous darkness—and the time fixed for retiring to rest. Reading, study, or application to the practice of a trade are the resources offered; but their efficacy is greatly impaired by the insufficiency and inferiority of the artificial light provided by Government for these and other barrack purposes.

The medium through which this is, I believe, almost universally supplied to Indian barrack rooms consists of a lamp formed by a cotton wick kept floating by means of cork buoys upon a surface of crude and often very opaque oil, poured upon water in a glass vessel. Much of the illuminating power of such a lamp is necessarily lost, owing to the unfavourable medium through which the downward rays are transmitted; and not only does waste ensue, but great detriment and injury to the visual organs of the men who essay to read by its light, driving many a well-disposed man from his book or slate to the canteen or to the dram shop.

Instead of this oil I would propose that gas should be the illuminating medium employed; that, in effect, the oil issued to the men in barracks should be burnt in the form of gas instead of being consumed in nourishing the unsteady flame of a rude and imperfect lamp; and I am anxious to show, or to attempt to show that, far from being a source of enhanced cost to the State, it will be found productive of very great economy in a financial point of view, while at the same time the comfort and moral advantage of the soldier are strikingly ministered to.

I will take leave, in the first place, to consider this question as one of economy.

The common lamp oil usually issued for barracks in India costs about 1*s.* 3*d.* per gallon, a quantity which would supply about 36 to 40 open wick lamps for

three hours. From this same quantity from 100 to 120 cubic feet of the purest olefiant gas could be produced, sufficing for the consumption of 18 burners for three hours, at the rate of two cubic feet per hour per burner. Experiments by various eminent chemists have established that the illuminating power of coal gas ignited in an ordinary burner is to that of a common open oil lamp with a single wick, as 5 to $1\frac{1}{2}$; and as the intensity of oil gas is nearly double that of coal gas, it is safe to assume the proportion which its lighting power bears to that of an oil lamp at 8 to $1\frac{1}{2}$, or :: 16 : 3. It results from this that eight ordinary fish-tail oil-gas burners would produce as much light as 40 common oil lamps; and as 48 cubic feet of gas would suffice to supply the former for three hours, it is seen that if economy were exclusively studied, the supply of oil for barracks could, if gas were employed, be diminished by one half.

But the economical result goes even further. The retorts manufactured for the conversion of oil gas will produce it from any unctuous or greasy matter introduced into them; and as barrack kitchens in India abound in such refuse, it is easy to perceive how extensive a saving might be effected if all this were collected and employed in the production of gas.

Several valuable products also result from the manufacture, such as "lamp-" black," and, in small quantities, tar. The cost of an apparatus constructed on the plan of Major Fitzmaurice, whose experiments I had recently an opportunity of witnessing at Woolwich Dockyard, would be as follows:—

1. For an apparatus to supply 50 burners, 120*l.*
2. Do. do. 100 do. 230*l.*, and upwards in proportion.

The manipulation of the apparatus is extremely simple, and could be undertaken by any moderately intelligent man possessing some little acquaintance with the mechanic's art, of whom every regiment in India possesses many.

No purification is required, and the gas, after passing through cold water to reduce its high temperature, is fit for use.

For heating the retorts in India, jungle wood would be used, the cost being in almost all parts of the country insignificant.

A great and important benefit may thus be conferred on the troops employed in India without involving the State in any outlay beyond that at present incurred, save and except the cost of the apparatus to be furnished to each up-country barrack,—a cost which might, in fact, be soon covered by a small temporary diminution of the quantity of oil now issued for the men's use.

I feel sure from the experiments I have witnessed, that if gas were employed, more than double the illuminating power might be elicited from the regulation allowance of oil; while the light produced would be of the purest, most brilliant, and most healthy character.

Extracts from Note on Prostitution at Indian Stations, by Staff-Surgeon Grierson, Kurrachee.

Formerly when a ship was in harbour boats might be seen in the evening lying near full of prostitutes, when, at a given signal, permission being granted to come alongside, the sailors might then be seen rushing to the boats, each to select his partner for the night, as a butcher might be imagined to select fat lambs from a flock. To the credit of Sir Charles Malcolm, a system so abhorrent to right feeling, and so prejudicial in many ways, was no sooner officially brought under his notice than it was abolished.

Lock hospitals, so called, were next abolished by order of Government, at the instance, urgently repeated, of the Bishop of Bombay, and supported by the strong arguments of the then Metropolitan of India. Regret was very generally felt and often expressed at this abolition; hence the indifference or hostility with which any further step was encountered.

In an evil hour, and in ignorance apparently of what had been done in former times, in the extinction of *Lal Bazaars*, and of the late orders of Lord F. Fitzclarence, it was resolved to institute what was called a venereal dispensary at Kurrachee. It was pointed out in opposition to the proposal that for 500 years at least the law of England regarded the prostitute as a

criminal, that this was also the law of India, by the enactments of its Supreme Council, and that it was the law of the military bazaars of the Bombay Presidency; that the object of legislation has uniformly been not the regulation of an admitted evil, or the protection in any way of those who favour or commit it, but the punishment of the offenders and the suppression of the crime. It was shown that Christianity condemns prostitution. What is rooted in religion and embodied in law must also be seated in human nature, unless indeed the first be fictitious, and the second usurp a power and an office where neither are rightfully due. So long as modesty, integrity, self-restraint, honour, chastity, are reputable qualities of the individual, commendable and excellent, so long must it of necessity be that the dissolute, those abandoned to the sway of one of the basest passions, the sexual appetite, shall be held as evil-doers, corrupt and corrupters by practice and example, enemies to social well-being, fallen or who ought to fall from the privileges, protection, and enjoyments of society. It is the voice of reason and of nature, that if we would cherish whatever is loveliest and dearest in our estimate of human character, we must set the stamp of reprobation on all that tends to diminish its production, to render precarious its continuance, to impair its lustre, or to annihilate its existence. Nature, religion, and law, then, all concur in visiting the prostitute with their peculiar penalties—moral, spiritual, and legal, and heavy is the responsibility of those who lightly set them aside. What little soever notice we bestow on the prostitute is countenance bestowed; and how little soever we regulate her affairs, it is protection and reward.

But it might be objected,—it is not reasonable to deny the woman aid in her distress, any more than to forbid assistance to be given in any case where the imprudence of the sufferer has been the occasion of his malady. To this it is replied, all sufferers from disease, though themselves the cause of it, address an irresistible claim to the sympathy and aid of the physician. On this there is, there can be, no dispute. Patients suffering from *delirium tremens* are cared for with the greatest solicitude; and so are women labouring under venereal disease, nor is less done for the greatest of all criminals, the man who with sacrilegious hands has violated in his own person the sanctuary of life. But no rational man can fail to have some respect to the consequences of his acts, and in the instances advanced, or any other of the like kind, when a comparison is instituted, it is easy to see that a special peculiarity attaches to the case of the unfortunate female. In other instances, the victims of self-inflicted disease, when restored to health, are thrown upon their own responsibility. The health and improved condition they have gained form no necessary preparation for the unavoidable issue of renewed vicious indulgence. The lesson which teaches the connexion of vice and suffering has been brought home to personal experience; on this may be grounded an exhortation and appeal to a mind consciously awakened to see the nearness and magnitude of a danger hitherto little appreciated; and the conviction which springs from these truths is happily found to be not always unavailing. But the restoration to health of the female is the very condition of the resumption of her nefarious occupation, and, qualified again as she is to this resumption, her necessities impel her. She may feel the sense of responsibility keenly, may weep over the past experience of her sorrows, may shudder at the prospect the future offers to her; but we have qualified her to tread the path she trod before; taken from her the provision she got before, and that thorny path she must tread again. Now to warn, exhort, dissuade from evil in such circumstances, if that be all we do, is little better than hypocrisy, and means little else than reproach. And we see ourselves reduced to this extremity, that either we must act in a way outrageous to humane feeling, or, by our silence, though accompanied with inexpressible pain, seem to countenance a course which we abhor.

Let there be simply a dispensary or hospital opened, provided with necessaries and the requisite attendants for the reception and cure of women who live by prostitution, and become diseased by following this mode of life, where shelter, care, and cure are all gratuitous, and the condition of obtaining the advantage of them is the attendance or residence of the applicant; let the plan be as remote from the continental system of Europe, registration, domiciliary visits, compulsory inspection, and medication, as possible, and as consistent with the liberty of the subject and the protection afforded by law as can be desired; still there attaches to the modified scheme a character, the vices of

which exclude it from the category of legal institutions, and bid away from it the cold approval the moralist and philanthropist would feel disposed at first sight to bestow upon it.

Tried by practical application, the institution and the associations it provokes challenges only reprobation. This point was put forward in reference to the establishment set on foot at this place, and I desire it should be pointedly mentioned, that nothing has appeared in public to tend to the belief that, though the establishment at Kurrachee was abolished, yet similar establishments do not exist at Poona and Belgaum to this hour. The remarks to be repeated here, therefore, have a living interest at this moment. Were it otherwise, yet their repetition is desirable, for it seems as if most minds never contemplated any other means of abating the evils of the venereal disease amongst troops except the establishment of lock hospitals, and the proposal is continually coming to view, put forward, it is believed, by men who not only know nothing better, but have never heard of any other plan or possibility of dealing with an admitted evil, a detriment, and reproach. Women of disreputable character the law enjoins should be expelled from cantonments; but this is not done. They are countenanced and permitted to remain. When sick, they are lodged, fed, and receive care and medicine at the public expense, as if they were valuable members of the community, or servants of the State. And what a contrast do the industrious and decent inhabitants, as respects their treatment or the neglect of their necessities, afford! It was proposed to take their school from them for the accommodation of their vicious neighbours. When sick, what care do they receive? A few applicants and an occasional inmate, of the female sex, are seen at the general hospital; but let returns of all the hospitals in Sindh be called for, excepting at the same time the patients in jail, and perhaps not half-a-dozen will be found. Again, I have attended, in the dwellings of the native poor, women in child-birth, some of whom I am certain as one can be in such matters, but for help must have died, and some of whom earlier relief would have saved from death; but who ever heard in the provinces, and only lately at the presidency, of a maternity hospital, an institution than which few could be more desirable, and none bear a higher stamp of Christian philanthropy? In plain terms, and this statement in its general extent cannot be denied, the vicious, whom law, religion, and morality condemn, receive indulgence, protection, and support in their necessities from the public money, while the honest, industrious, respectable, however necessitous, are not thought of, or viewed with unconcern, apathy, or contempt.

If we inquire what effects such a practice is likely to have on the minds of others, we shall find it far from salutary. The woman is encouraged and confirmed in her evil courses. The soldiers are countenanced in crime; and if they contract disease will be apt enough to reproach the Government which has held out a false hope of immunity. Decent inhabitants cannot but be perplexed when they think that a Government, which in principle approves of honesty and industry, should yet make its especial favourites the impure, the corrupt, the disorderly; and in their bewilderment they will probably lose what little hold on their confidence and affection, as nature and duty teach them, the rulers of the country are entitled to and enjoy. Nor is it impossible that the parents of Christian youth in the cantonments look with dread on an establishment where the modesty of tender years may be endangered and vicious habits contracted under sanction of authority.

But as respects the soldier, who rejoices not in his improved condition of late years? Who is there who sympathizes not with every regulation directed to his elevation and well-being as a man and as a Christian? And not a little has been done, and with no little effect in late years. The schools in regiments, the Ten Years' Enlistment Bill, good-conduct badges and pay, all indicate the same purport, and tend to realize the same desirable result. All address themselves to his capabilities of improvement and moral elevation, and all are intended, by bettering the condition of the soldier, to raise the character of the service, facilitate the supply of men to constitute an armed force, and to make that force when constituted more valuable and efficient. Now the institution under review is not in harmony with these regulations and usages. It does not facilitate their action, but is opposed to them and detrimental. The dissolute soldier, the man under the tyranny of lust, is the discontented, needy,

dishonest, drunken, untruthful, quarrelsome, disobedient, and negligent soldier; and this institution is designed for men like these, or will make men like these. The good can have no benefit by it. Their concern with it is to deplore its existence, and regard it with alarm and abhorrence. It is therefore the antagonist of the school, the church, the reading room, the playground, and everything which is brought into use or may be brought into use to make the soldier an instructed, a contented, and a happier man. I can conceive the incredulity with which those who best love the soldier, and most earnestly, consistently, and successfully seek his amelioration, would hear of an institution like this being organized in these times (May 1858), and at this time of day; but I cannot conceive the horror with which many would receive the evidences of its existence.

If it should be asked, how then deal with the offenders in the bazaars of this class? The answer is, as the law directs. Expulsion is that law. If it be objected that this is cruel, that evils will follow it, as well might it in any case be said that justice is cruel, or the law tyranny. Execution of the law occasions distress, gives rise to evils; but execution is not a daily office, and it is enforced that greater distress and greater evils may be anticipated. And as for evils to come, the fallacy is easily exposed. We must not do evil that good may come is an admitted truth; as we must not do good lest evil may arise is an oft-enacted fallacy. The good in the latter case is positive, the evil only contingent, and if the evil comes, for every wrong and for every evil there is a remedy. The course therefore is plainly marked, and if we believe in a moral governor of this world who delights in goodness, we cannot refuse to acknowledge that in this very faith He has given us ample encouragement to prosecute what is good, and just reason to think that He will favour the good and set His face against all that is evil.

It has been already shown how repugnant this establishment is to law, religion, and morals, and it is not meant to recur to that view of the subject. But to cut off all objections, if there must be an institution for the care of prostitutes, it is desirable to indicate the principles on which it might be legally founded and honourably conducted. Examples of institutions of this kind are seen in Great Britain and Ireland, and the great Scott, the commentator, was chaplain of the London Lock Hospital. These institutions are signalized by the aspect of reform of character as much as by that of punishment. The law does not forego its claim to deal with prostitutes as criminals, but religion steps in and deals with them, and tries to make them penitents. By the various names of Magdalene asylums, lock hospitals, penitentiaries, and such like, these houses of correction are known, and the objects common to all are by sobriety, cleanliness, and medical assistance, by a regular series of labour, by solitary confinement during the intervals of work, and by religious instruction, to preserve and amend the health of the offenders, to inure them to habits of industry, to guard them from pernicious company, to accustom them to reflection, and to teach them the principles and practice of moral and social duty. Institutions like these are within the bounds of law, are approved by reason, and sanctioned by religion. Institutions with attributes like these are schools or churches, as well as gaols. But to aggregate prostitutes in a public building and give them public support where no such attributes hallow the scene, is to constitute neither a church nor a school nor a gaol, but a brothel.

In another letter I took occasion to quote the recorded opinions, or, in one instance, oral testimony, of Lord F. Fitzclarence, Sir Bartle Frere, General Jacob, Colonel Edwardes, and Sir John Lawrence on the subject in question, and this weight of authority was thrown into the scale which bore the condemnation of the lock hospital system. Lord F. Fitzclarence, through the Adjutant-General, announces his views thus:—"I am directed to intimate "that after giving the whole subject his best attention, his Excellency con- "curs with his predecessors in command of the army, that police measures for "preventing the infection of the soldiers with the venereal disease cannot be "carried further than therein ordered (this alludes to orders for expulsion) "without involving the certain degradation and oppression of many women "of respectable character, and occasioning other evils which, in his Lordship's "opinion, would be much greater than that which it is the object to remedy." General Jacob, amongst other remarks, makes the following:—"I would not

" interfere with these women in any way, and although it might be good " policy to provide dispensaries or hospitals, to which such persons might " resort if they chose, there should be none specially set apart for them. " The proper and only wise method of reducing this disease is to improve the " condition, the state of moral being of those who resort to these women. " Coercion of every kind always increases these evils. Moral forces alone " are of any value." He adds, speaking of the Sindh horsemen, the elder, graver, and better part of the soldiers, seven-eighths of the whole number probably, have their families here, and do not resort to public women, except when they employ them at nauches, &c. &c. Colonel Edwardes and Sir John Lawrence both concur in the propriety of expulsion of prostitutes, and signalize the restriction on marriage amongst the English troops as a great evil and hardship, and assert that married men are the better soldiers, and women and children no impediment in time of service, as they are left in cantonments.

To this weight of authority, I would add one or two facts. The 4th company of reserve artillery at present stationed here (1858) I have had charge of for 14 months, and the strength, inclusive of men attached from other companies at Hydrabad and Shikarpoor, has been the average of 107 men per mensem. Of primary cases of venereal affection there have been treated 13, which by calculation gives for 1,000 men per mensem for one year 111 cases. I have had charge also of the depôt 1st Fusiliers for nearly 19 months. Of these months I omit the first, as it represents the whole regiment not the depôt. The strength for these months is 95, as in that time about 150 recruits passed through. The primary venereal affections in these 18 months are 20, which by calculation would give per 1,000 per mensem in the year cases, 140. The mean of the Artillery and Fusiliers is 125, which divided by 12 for 12 months gives an average of admissions per mensem in a European regiment 1,000 strong of 10½ nearly. I served for five years with a native regiment, the 1st Grenadiers, an abstract of the return of which I have now before me. The strength was 781 per annum, the number of primary venereal affections amongst the privates (there was not one amongst the native regimental officers) was 77, the annual average was therefore 15. This by calculation for 1,000 gives admissions 19 per annum, and per mensem $1\frac{7}{12}$. When we compare, therefore, the condition of a European regiment and of a native regiment in this matter of venereal infection, the native regiment appears to a greater advantage, by five times over, than the European. And it will be extremely difficult to find any satisfactory explanation of this deplorable fact, other than that in the European regiment marriage is restricted and widows unkindly used; whereas in the native regiment marriage is free, and the native soldier's family generously treated.

It was already stated that these representations were followed by the destruction of the ill-featured institution which was set up here. But whether its congeners at Poona and Belgaum shared the same fate has never, I believe, been made public. If these exist the reasons urged are as applicable to them as they were in the instance which gave rise to them. But the subject would be imperfect indeed if we stopped here. The system is called for, it is not said wisely called for, because of the deep pervading power of the sexual passion, and the evils which arise from its promiscuous indulgence. Now the wisest law that ever was promulgated on this subject, the only one which deals a deadly blow at the heart of the vicious and debasing crime in question, is the simple one, " Let every man have his own wife, and every woman " her own husband." How complex, how difficult, how unavailing all other legislation on the subject except this, and this how plain, how obvious, how admirable! This law, however, has been set aside; there has been wailing in families, and immorality in public places, because this law has been set aside. The British public though late, has recognized the fact, and sympathises with those who are sufferers by it. The Government will not overstep public feeling, but concentrate its action, and gain merited applause if it lends ear to a law which should never have been violated. But the marriage of the soldier will entail additional expense on the public. If it be so, and this may on a comprehensive view be doubted, let the public know why, and it will not complain. Besides, does any one think that the pay of the soldier is ever to continue at the venerable 13 pence a day? Sir Archibald Alison has publicly stated his opinion that the soldier's pay ought to be 20 pence

a day. With changed times, is everything to change but the soldier, his pay, his prospects, his happiness? I conclude then that these two principles of the repression not recognition of prostitution, and of the permission not restriction of marriage amongst the European soldiers in India, indicate clearly what is needed in the way of Christian and public duty, and what is best for the elevation of the soldier, as respects morality, health, happiness, and efficiency for the public service. And I add my conviction that this, the true remedy, bounty to the soldier, not the prostitute, will, whenever applied, declare itself in its simplicity, perfect propriety, efficiency for the end desired, and the many priceless advantages it will bring in its train.

Abstract of Report on the Meteorology of India, by James Glaisher, Esq. F.R.S., &c.

Atmospheric Pressure.

Throughout India the daily increase and decrease in the reading of the barometer takes place with great regularity. At about 4 o'clock in the morning a minimum reading occurs, it then turns to increase, and at about 10 o'clock a.m. a maximum; it decreases till about 5 p.m. when a second minimum pressure takes place, and a second maximum pressure is attained at about 11 p.m. The maximum reading therefore occurs one or two hours before noon or midnight, and the minimum reading at about one or two hours before sunrise or sunset.

The actual reading is greater at its morning maximum than at its evening maximum, and generally lower at the evening minimum than at the morning minimum. The time of evening maximum remains pretty nearly constant.

The difference between the mean daily readings of the barometer on two consecutive days, seldom exceeds 0·2 inch, the whole daily range is generally less than 0·1 inch. The daily ranges are somewhat larger in winter than in summer.

The barometer reading is highest in January, and decreases gradually till June, and increases gradually from July to December all over India.

The decrease of readings from January to June is 0·26 inch in the Presidencies of Madras and Bombay and about 0·44 inch in that of Bengal. The increase from July to December is about the same amount in the respective presidencies.

The mean atmospheric pressure is subjected to very little change from year to year.

The change in the atmospheric pressure from month to month is very constant in different years, and the mean annual pressure is subjected to but very little change from year to year as before remarked.

Effect of a change of 1° of latitude on high day temperature of the air.

The effect of an increase of one degree in latitude, is as follows in the different months .—

In January a decrease of	0°·7	for an increase of 1° of north latitude.
In February a decrease of	0°·7	" "
In March a decrease of	0°·3	" "
In April an increase of	0°·2	" "
In May an increase of	0°·3	" "
In June an increase of	0°·4	" "
In July an increase of	0°·4	" "
In August an increase of	0°·1	" "
In September an increase of	0°·2	" "
In October an increase of	0°·1	" "
In November a decrease of	0°·3	" "
In December a decrease of	1°·1	" "

Effect of a change of 1° of longitude on high day temperature in India.

At places situated between the latitudes 15° and 20° the high day temperature may be approximately determined by the use of the following formulæ :—

January -	$81° - (\text{lat.} - 21\tfrac{1}{2}°) \times 0°{\cdot}7 - (\text{long.} - 72°) \times 0°{\cdot}4$
February -	$86 - (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}7 - (\text{long.} - 72) \times 0{\cdot}4$
March -	$91 - (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}3 - (\text{long.} - 72) \times 0{\cdot}4$
April -	$96 + (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}2 - (\text{long.} - 72) \times 0{\cdot}5$
May -	$99 + (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}3 - (\text{long.} - 72) \times 0{\cdot}3$
June -	$95 + (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}4$
July -	$92 + (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}4$
August -	$88 + (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}1$
September -	$88 + (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}2 - (\text{long.} - 72) \times 0{\cdot}1$
October -	$90 + (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}1 - (\text{long.} - 72) \times 0{\cdot}4$
November -	$87 - (\text{lat.} - 21\tfrac{1}{2}) \times 0{\cdot}3 - (\text{long.} - 72) \times 0{\cdot}5$
December -	$83 - (\text{lat.} - 21\tfrac{1}{2}) \times 1{\cdot}1 - (\text{long.} - 72) \times 0{\cdot}6$

At the places situated between the latitudes 20° and 25°, the high day temperature may be approximately determined by the use of the following formulæ:—

January	73° − (lat. − 27°) × 0·7 − (long. − 80½°) × 0·4
February	76° − (lat. − 27°) × 0·7 − (long. − 80½°) × 0·4
March	85° − (lat. − 27°) × 0·3 − (long. − 80½°) × 0·4
April	93° + (lat. − 27°) × 0·2 − (long. − 80½°) × 0·5
May	98° + (lat. − 27°) × 0·3 − (long. − 80½°) × 0·3
June	97° + (lat. − 27°) × 0·4
July	93° + (lat. − 27°) × 0·4
August	89° + (lat. − 27°) × 0·1
September	89° + (lat. − 27°) × 0·2 − (long. − 80½°) × 0·1
October	87° + (lat. − 27°) × 0·1 − (long. − 80½°) × 0·4
November	79° − (lat. − 27°) × 0·3 − (long. − 80½°) × 0·5
December	71° − (lat. − 27°) × 1·1 − (long. − 80½°) × 0·6

At places situated to the north of latitude 25°, the high day temperature may be approximately determined by the use of the following formulæ:—

January	73° − (lat. − 27°) × 0·7 − (long. − 80½°) × 0·4
February	76° − (lat. − 27°) × 0·7 − (long. − 80½°) × 0·4
March	85° − (lat. − 27°) × 0·3 − (long. − 80½°) × 0·4
April	93° + (lat. − 27°) × 0·2 − (long. − 80½°) × 0·5
May	98° + (lat. − 27°) × 0·3 − (long. − 80½°) × 0·3
June	97° + (lat. − 27°) × 0·4
July	93° + (lat. − 27°) × 0·4
August	89° + (lat. − 27°) × 0·1
September	89° + (lat. − 27°) × 0·2 − (long. − 80½°) × 0·1
October	87° + (lat. − 27°) × 0·1 − (long. − 80½°) × 0·4
November	79° − (lat. − 27°) × 0·3 − (long. − 80½°) × 0·5
December	71° − (lat. − 27°) × 1·1 − (long. − 80½°) × 0·6

TABLE showing the observed Mean Decrease of High Day Temperature with Increase of Elevation.

Influence of elevation on high day temperature in India.

MONTHS.	Presidency, Number of Stations, and Mean Elevation.							
	Bombay. Mean of 9 Stations, 1,450 ft.	Madras. Mean of 3 Stations, 1,524 ft.	Bombay. Mean of 3 Stations, 2,176 ft.	Madras, Bangalore, 2,874 ft.	Bengal, Cherrapoongee, 3,591 ft.	Bombay. Mean of 3 Stations, 4,018 ft.	Madras, Wellington, 5,880 ft.	Bengal, Darjeeling, 6,473 ft.
	°	°	°	°	°	°	°	°
January	− 2	− 2	− 4½	− 4½	− 13	− 11	− 16½	− 23
February	− 2	− 1	− 2½	− 3½	− 12	− 11	− 21½	− 25
March	− 1	− 2	− 1	− 2	− 18½	− 9½	− 19	− 28
April	0	− ½	− ½	− 4½	− 20½	− 11½	− 23½	− 33
May	− 3	− 1	− 4	− 2	− 23½	− 14½	− 20	− 35
June	− 6	− 7	− 8	− 7	− 25½	− 14½	− 17½	− 32
July	− 8	− 6	− 7	− 3	− 19½	− 18½	− 12½	− 29
August	− 5	− 5	− 7	− 7	− 18	− 17	− 13	− 24
September	− 6	− 4	− 8	− 5	− 17	− 16	− 12	− 24
October	− 5	− 5	− 6	− 4	− 14	− 16	− 12	− 26
November	− 4	− 3	− 4	− 5	− 15½	− 13½	− 16½	− 22
December	− 3	− 1	− 8	− 4	− 14½	− 14	− 10	− 19

The results for high day temperature, as found for the same elevation in the different presidencies, are sufficiently accordant to show that the decrease for the same elevation is the same everywhere. The following are the most probable values.

Calculated Decrease of High Day Temperature in India with an Increase of Height up to 9,000 feet above the level of the sea, for every month.

Months.	Height in Feet.								
	1,000	2,000.	3,000.	4,000.	5,000.	6,000.	7,000.	8,000.	9,000.
	°	°	°	°	°	°	°	°	°
January - -	1¾	4	8	11¼	15	19	23½	27¾	32
February - -	2	4	6½	11¾	16½	21½	26¾	32	37
March - -	1½	3¾	7	11½	17	22¾	28½	34¼	40
April - -	¾	3	8	13¾	21	27½	34½	41	47½
May - -	1¼	4¾	10	15¼	20¼	27¼	36	44½	53
June - -	4½	8½	13¼	18	23	27¾	33	38	43
July - -	4½	8¾	13¼	17½	22	26¼	30½	34¾	39
August - -	3¼	7	10½	14½	18	21¾	25½	29¼	33
September -	3¼	6¾	10¼	13¾	17	20¾	24¾	28¾	32¾
October - -	3¼	6¾	10½	14¼	18¼	22	26	30	34
November -	2¼	5½	8¾	12	15¼	18¾	22¾	26¾	30¾
December -	1½	5	8¾	11¾	15¾	18¼	21	23½	26

From these the approximate high day temperature may be determined at any elevation in India, when the same element is known at a lower elevation.

Influence of latitude on low night temperature in India.

The effect of latitude upon low night temperature is very decided, and large in amount in the winter months. It is small in amount, and almost insensible, in the summer months. It seems to be uniform in each month all over India; and the following are the most probable changes in this element for an increase of one degree of north latitude in each month:—

In January a decrease of 1·4° for an increase or 1° of north latitude.
In February a decrease of 1·2° ,,
In March a decrease of 1·0° ,,
In April a decrease of 0·5° ,,
In May, In June, In July, In August, In September — no sensible change, the low night temperatures are nearly alike at every place.
In October a decrease of 0·5° for an increase of 1° of north latitude.
In November a decrease of 1·0° ,,
In December a decrease of 1·2° ,,

From these values, which from their general agreement in all latitudes must be near the truth, it appears that, from November to March, the nights at northern stations are much colder than at southern stations, generally exceeding a degree of temperature in amount for every degree of greater north latitude. In the months of April and October they are colder, but to about one-half of the amount in the other months. Whilst in the remaining period of the year, viz., from May to September, there seems to be no sensible difference in the low night temperature throughout the whole of India.

The following table shows the effect of an increase of 1° of East Longitude on Low Night Temperature.

Effect of longitude on the low night temperature.

Months.	Latitudes N.			
	South of 15°.	15° to 20°.	20° to 25°.	25° to 30°.
	°	°	°	°
January - -	− 1·6	+ 0·2	+ 0·2	+ 0·2
February - -	− 1·7	+ 0·2	+ 0·4	+ 0·4
March - - -	− 1·4	+ 0·1	+ 0·2	+ 0·2
April - - -	− 0·8	+ 0·3	+ 0·2	+ 0·2
May - - -	− 0·3	+ 0·1	+ 0·1	+ 0·1
June - - -	+ 0·3	+ 0·1	+ 0·1	+ 0·1
July - - -	+ 0·5	+ 0·2	+ 0·2	+ 0·2
August - - -	+ 0·3	+ 0·1	+ 0·1	+ 0·1
September - -	0·0	+ 0·1	+ 0·2	+ 0·1
October - - -	− 0·2	+ 0·1	+ 0·1	+ 0·1
November - -	− 0·5	+ 0·2	+ 0·2	+ 0·2
December - -	− 1·0	+ 0·3	+ 0·3	+ 0·3

The greatest changes are in those latitudes south of 15°, amounting to a decrease of low night temperature to more than 1½° for each degree of greater east longitude in the months of January and February; decreasing to a little less than 1½° in March, to ¾° in April, and to ¼° in May: a change then takes place, and, for the months from June to September, those places with greater east longitude are from ¼° to ½° warmer for each degree of longitude. In September, longitude seems to exercise no influence on this element, and in October, the lower night temperature, as at the beginning of the year, sets in, and which by December amounts to 1° of lower temperature for one degree of east longitude. These results, however, can be looked upon as indications only.

The same general laws prevail in higher parallels of latitude, viz., north of 15°; and the results agree very well together, and the same coefficient may be used in the different parallels of latitude.

As both the coefficients in latitude and longitude at stations north of 15° are moderately satisfactory, the mean monthly low night temperature at stations within a few hundred feet of the surface may be calculated from the following formulæ :—

An approximation to the low night temperature at any place in India may be found as follows :—

At places south of 15° north latitude.

From the very small range of temperature in the presidency of Madras south of parallel of 15° of north latitude, the low night temperature may be readily found by applying subtractively to the monthly mean temperature the one half of the monthly daily range.

At places situated between the latitudes 15° and 20°, the low night temperature may be approximately determined by the use of the following formulæ :—

In January -	$59 - (\text{lat.} - 21\frac{1}{2}) \times 1{\cdot}4 + (\text{long.} - 72) \times 0{\cdot}2$
In February	$62 - (\text{lat.} - 21\frac{1}{2}) \times 1{\cdot}2 + (\text{long.} - 72) \times 0{\cdot}2$
In March -	$69 - (\text{lat.} - 21\frac{1}{2}) \times 1{\cdot}0 + (\text{long.} - 72) \times 0{\cdot}1$
In April -	$75 - (\text{lat.} - 21\frac{1}{2}) \times 0{\cdot}5 + (\text{long.} - 72) \times 0{\cdot}3$
In May -	$81 + (\text{long.} - 72) \times 0{\cdot}1$
In June -	$81 + (\text{long.} - 72) \times 0{\cdot}1$
In July -	$79 + (\text{long.} - 72) \times 0{\cdot}2$
In August -	$78 + (\text{long.} - 72) \times 0{\cdot}1$
In September	$77 + (\text{long.} - 72) \times 0{\cdot}1$
In October -	$73 - (\text{lat.} - 21\frac{1}{2}) \times 0{\cdot}5 + (\text{long.} - 72) \times 0{\cdot}1$
In November	$64 - (\text{lat.} - 21\frac{1}{2}) \times 1{\cdot}0 + (\text{long.} - 72) \times 0{\cdot}2$
In December	$59 - (\text{lat.} - 21\frac{1}{2}) \times 1{\cdot}2 + (\text{long.} - 72) \times 0{\cdot}3$

At places situated between the latitudes 20° and 25°, the low night temperature may be approximately determined by the use of the following formulæ :—

In January -	$53 - (\text{lat.} - 27) \times 1{\cdot}4 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In February	$59 - (\text{lat.} - 27) \times 1{\cdot}2 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}4$
In March -	$65 - (\text{lat.} - 27) \times 1{\cdot}0 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In April -	$74 - (\text{lat.} - 27) \times 0{\cdot}5 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In May -	$81 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In June -	$83 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In July -	$82 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In August -	$79 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In September	$79 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In October -	$71 - (\text{lat.} - 27) \times 0{\cdot}5 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In November	$60 - (\text{lat.} - 27) \times 1{\cdot}0 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In December	$55 - (\text{lat.} - 27) \times 1{\cdot}2 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}3$

At places situated to the north of latitude 25°, the low night temperature may be approximately determined by the use of the following formulæ :—

In January -	$53 - (\text{lat.} - 27) \times 1{\cdot}4 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In February	$59 - (\text{lat.} - 27) \times 1{\cdot}2 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}4$
In March -	$65 - (\text{lat.} - 27) \times 1{\cdot}0 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In April -	$74 - (\text{lat.} - 27) \times 0{\cdot}5 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In May -	$81 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In June -	$83 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In July -	$82 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In August -	$79 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In September	$79 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In October	$71 - (\text{lat.} - 27) \times 0{\cdot}5 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}1$
In November	$60 - (\text{lat.} - 27) \times 1{\cdot}0 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}2$
In December	$55 - (\text{lat.} - 27) \times 1{\cdot}2 + (\text{long.} - 80\frac{1}{2}) \times 0{\cdot}3$

Influence of elevation on low night temperature in India.

The values in the following table are evidently the same at different parts of India, or, in other words, the effect of elevation on the low night temperature is the same in all latitudes, and lessens those at low elevations by the same amount. The values at Bangalore in the winter months are too large.

Observed Mean Decrease of Low Night Temperature with Increase of Elevation.

Months.	Presidency, Number of Stations, and Mean Elevation.							
	Bombay. Mean of 9 Stations, 1,450 ft.	Madras. Mean of 3 Stations, 1,524 ft.	Bombay. Mean of 3 Stations, 2,176 ft.	Madras. Bangalore, 2,874 feet.	Bengal. Cherrapoongee, 3,591 ft.	Bombay. Mean of 3 Stations, 4,018 ft.	Madras. Wellington, 5,880 feet.	Bengal. Darjeeling, 6,473 feet.
	°	°	°	°	°	°	°	°
January - - -	0	− 0½	− 3½	− 14	− 3	− 5	− 13½	− 14
February - - -	0	− 4	− 3	− 12½	− 10¼	− 5	− 16	− 20
March - - -	+ 0¼	− 3½	− 5	− 8	− 10¾	− 5	− 16	− 19
April - - -	+ 1	− 4	− 5	− 10	− 10¾	− 9½	− 20	− 24
May - - -	− 4	− 2	− 6	− 10	− 15	− 14	− 17	− 28
June - - -	− 6	− 4	− 7	− 12	− 17	− 16	− 16	− 25
July - - -	− 4	− 6	− 6	− 10	− 14	− 15	− 18	− 24
August - - -	− 5	− 6	− 7	− 10	− 12	− 14	− 14	− 21
September - - -	− 5	− 5	− 8	− 8	− 12	− 13	− 19	− 23
October - - -	− 2	− 5	− 7	− 9	− 16¾	− 10½	− 14	− 21
November - - -	+ 0¼	− 0½	− 5	− 8	− 13¾	− 6	− 12½	− 16
December - - -	0	− 1	− 4	− 10½	− 9¾	− 7	− 8½	− 16

The numbers in the preceding table were treated precisely as those in the preceding section, and the following are the final results :—

Calculated Decrease of Low Night Temperature in India, with an Increase of Height up to 9,000 feet above the level of the sea, for every month.

Months.	Height in Feet.								
	1,000.	2,000.	3,000.	4,000.	5,000.	6,000.	7,000.	8,000.	9,000.
	°	°	°	°	°	°	°	°	°
January - -	0½	3½	6¼	8½	10¾	13	15	17	19
February - -	1¾	4½	7½	10½	13½	16¾	20	23¼	26½
March - -	1½	4	6¾	9¾	13	16¼	19¾	23¼	26½
April - -	1¾	4¾	8	12	16¾	21	25¼	29½	33¾
May - -	2¼	6	9¾	13½	17½	22¼	29	35	41
June - -	3	6½	10½	14¼	18	21¾	26	30¼	34½
July - -	3	6	9¾	13¼	16¾	20½	24¼	28	31¾
August - -	3½	6¾	9¾	13	16	19	22	25	28
September -	3¼	6½	10	13¼	16¾	20	23½	27	30½
October - -	2½	6	9¼	12¾	15¾	19	22	25	28
November -	0½	3	5¾	9¾	12½	15	17½	20	22½
December -	0½	3¼	6	8½	11	13½	16	18½	21

These numbers are satisfactory and leave but little doubt on the mind as to their general accuracy, and may be used with some confidence in deducing the low night temperatures all over India.

Mean daily range of temperature.

Mean Daily Range of Temperature of the Air, in the three Presidencies of Madras, Bombay, and Bengal, at different Elevations.

Presidency.	Madras.				Bombay.						Bengal.				
Latitude - - -	14° 40′ N.	17° 14′ N.	12° 27′ N.	11° 25′ N.	21° 22′ N.	20° 35′ N.	16° 27′ N.	24° 45′ N.	18° 12′ N.	17° 59′ N.	26° 49′ N.	30° 32′ N.	25° 12′ N.	29° 20′ N.	27° 2′ N.
Longitude - -	79° 26′ E.	77° 46′ E.	77° 38′ E.	77° 5′ E.	71° 44′ E.	75° 3′ E.	74° 38′ E.	72° 49′ E.	73° 54′ E.	73 °30′ E.	80° 33′ E.	74° 55′ E.	91° 45′ E.	79° 30′ E.	88° 18′ E.
Height - - -	126 feet.	1,650 feet.	3,000 feet.	6,000 feet.	215 feet.	1,665 feet.	2,354 feet.	4,000 feet.	4,200 feet.	4,500 feet.	527 feet.	1,128 feet.	4,118 feet.	6,400 feet.	7,000 feet.
Months.	Mean of 9 Stations.	Mean of 2 Stations.	Banga-lore.	Wel-lington.	Mean of 11 Stations.	Mean of 10 Stations.	Mean of 3 Stations.	Mount Aboo.	Poo-rundhur.	Mahabu-leshur.	Mean of 10 Stations.	Mean of 4 Stations.	Cherra-poongee.	Nynee Tal.	Dar-jeeling.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
January - - -	12	12	20	8	22	19	22	28	9	11	20	19	9	36	11
February - -	12	16	20	6	24	20	22	31	10	13	17	20	15	34	12
March - - -	13	16	18	8	22	20	22	22	11	16	20	19	11	34	11
April - - -	11	16	15	5	21	20	22	26	12	15	19	24	8	33	10
May - - -	12	14	19	8	18	18	17	26	10	14	17	20	8	31	10
June - - -	10	9	15	8	14	15	10	26	15	6	14	16	5	24	7
July - - -	8	9	14	12	13	9	8	16	6	4	11	15	5	18	6
August - - -	9	9	12	10	10	9	8	12	4	4	10	16	4	18	7
September - -	9	10	12	16	11	10	10	16	8	2	10	17	5	22	9
October - - -	9	10	13	9	17	13	15	18	7	7	16	19	8	30	11
November - -	10	10	12	4	23	18	17	24	8	13	19	22	16	33	15
December - -	12	12	8	10	23	20	20	30	11	12	16	19	11	32	13
Means - -	10	12	15	8	18	16	16	23	9	9	15	19	9	29	10

From these values, it seems that the daily range of temperature in the presidency of Madras is always small, in the winter months being but little more than one-half of that in the other presidencies, the variations in which are from 19° to 22°. In Madras in the summer months the daily range is somewhat smaller than in the winter months; in the other presidencies it becomes much smaller, till, in the months of July, August and September, the variation of daily temperature is nearly alike, and from 9° to 12° only at all parts of India. By comparing the daily range at different elevations together in the same presidency no certain difference is shown. In Madras, at Bangalore, at 3,000 feet, they are larger, whilst at Wellington, at 6,000 feet, they are smaller; but no information is given as to the position of the instruments. In Bombay the results at 1,665 feet seem to be a little smaller than those at 214 feet, whilst those at 2,320 feet, are very nearly the same as those at the lowest elevation. The numbers in the next two columns, at 4,500 and 4,200 feet respectively, agree with each other; but then those at Mount Aboo, at 4,000 feet, are twice as large. The same remark applies to the numbers in the last three columns. Upon the whole it seems that the range of temperature as the higher elevations differs but little from those at the lower elevations in the same parallel of latitude.

Observed mean temperature of the air.

In Madras the highest temperature of the day occurs about $0^h \cdot 30^m$ p. m. in the months of April and May; between 1^h p. m. and $1\frac{1}{2}^h$ p. m. in the months of January, February, March, August, September, October, November and December; and at nearly 2^h p. m. in the months of June and July. The average maximum temperatures are as follows: January 82°. February 85°, March 89°, April 93°, May 96°, June 97°, July 94°, August 93°, September 92°, October 88°, November 84°, and December 82°. The annual mean is $89\frac{1}{2}°$.

The highest temperature in the presidency of Madras reaches sometimes, though rarely, nearly to 110°; at Madras Observatory it was $107\frac{3}{4}°$ on the 18th of May 1849, and it was 108° on the 10th of June of the same year. These high readings are very rare, and at such times a very hot land wind is blowing. The thermometer at Madras seldom exceeds 98°.

The lowest temperature of each day takes place between $5\frac{1}{2}^h$ a.m. and 6^h a.m. in the months from April to November, and between 6^h a.m. and $6\frac{1}{2}^h$ a.m. in the remaining months. The times of minimum temperature thus precede sunrise by a few minutes.

The average minimum temperatures in each month are as follow: January 70°, February 73°, March $74\frac{1}{2}°$, April 80°, May and June 82°, July $80\frac{1}{2}$, August and September 80, October $77\frac{3}{4}°$, November 75°, and December 73°.

The lowest temperature sometimes falls to 63°; it was at this reading at Madras on the 28th January 1850. This low reading is of rare occurrence, as the temperature seldom falls below 67°.

The hottest day is about the 15th of June, when the mean temperature of the 24 hours, from several years Observations at Madras Observatory, is but little short of 90°, this value has varied in different years between 82° and 95°. The coldest is about the 9th of January; the mean temperature of this day is about $74\frac{1}{2}°$, the individual means varying from 72° to 77°. On the 20th of March and the 20th of October the thermometer is at its mean reading for the year.

The mean monthly temperatures in India at the same place do not undergo great variation.

The lowest and highest monthly temperatures at Madras in 55 years have been as follows:—

In January, 71° in 1819, and 79° in 1804 and 1828, showing a variation in this month of 8°.

In February 73° in 1816, and 81° in 1804 and 1825, showing a variation in this month of 8°.

In March, 73° in 1807, and 84° in 1801, 1802, and 1822, showing a variation in this month of 11°.

In April, 79° in 1821 and 1835, and 87° in 1815 and 1845, showing a variation in this month of 8°.

In May, 80° in 1814, and 90° in 1813, 1815, 1818, and 1849, showing a variation in this month of 10°.

In June, 83° in 1826 and 1835, and 91° in 1814, showing a variation in this month of 8°.

In July, 81° in 1834 and 1835, and 90° in 1824, showing a variation in this month of 9°.

In August, 78° in 1832, and 88° in 1824, showing a variation in this month of 10°.

In September, 81° in 1834, 1835, and 1836, and 88° in 1824, showing a variation in this month of 7°.

In October, 79° in 1835, and 84° in 1823, 1825, 1826, 1829, 1839 and 1850, showing a variation in this month of 5°.

In November, 75° in 1799, and 81° in 1804, 1806, 1823, 1824, 1828, and 1829, showing a variation in this month of 6°.

In December, 74° in 1813, 1815, 1835, and 1836, and 80° in 1822, showing a variation this month of 6°.

At Bombay the variation in temperature—

In January	in 12 years amounted to		4°	In July	in 12 years amounted to		2°
In February	„	„	4°	In August	„	„	3°
In March	„	„	3°	In September	„	„	2°
In April	„	„	3°	In October	„	„	2°
In May	„	„	3°	In November	„	„	5°
In June	„	„	4°	In December	„	„	3°

Effect of a change of 1° of latitude on the observed mean temperature.

The following are the most probable values for an increase of one degree of north latitude.

In January	a decrease of 1°0.	In July	an increase of 0°3.
In February	a decrease of 0·8.	In August	an increase of 0·2.
In March	a decrease of 0·5.	In September	an increase of 0·1.
In April	no change.	In October	a decrease of 0·2.
In May	an increase of 0·3.	In November	a decrease of 0·5.
In June	an increase of 0·4.	In December	a decrease of 1·1.

From these results it appears that from October to March the temperature is lower at northern stations than at southern, and from May to September they are warmer. In April the temperature seems to be very nearly the same at all stations, and there is but little difference in this respect in September. The greatest differences are in December and January, and which exceed 30° in amount, between the extreme south of the presidency of Madras, and north of that of Bengal.

Effect of longitude on mean temperature.

Effect of an Increase of 1° of East Longitude in the different Parallels of Latitude in India.

Months.	Latitudes N.			
	South of 15°.	15° to 20°.	20° to 25°.	North of 25°.
	°	°	°	°
January	− 0·7	− 0·3	− 0·2	− 0·1
February	− 0·7	− 0·3	− 0·1	− 0·1
March	− 0·6	− 0·3	− 0·1	− 0·1
April	− 0·2	− 0·3	− 0·1	− 0·1
May	+ 0·3	− 0·1	− 0·2	0·0
June	+ 0·8	0·0	− 0·1	− 0·2
July	+ 1·2	0·0	− 0·1	− 0·2
August	+ 1·2	− 0·1	− 0·1	− 0·2
September	+ 0·8	− 0·2	− 0·1	− 0·1
October	+ 0·3	− 0·3	− 0·1	− 0·1
November	− 0·2	− 0·2	− 0·1	− 0·2
December	− 0·7	− 0·3	− 0·2	− 0·2

The numbers in the column applicable to places situated south of 15°, are remarkable, and show that the stations on the Malabar coast differ very much from those on the Coromandel coast, in their monthly values, the former being of much higher temperature in the winter months, and of lower in the summer months, the change taking place between the months of April and May, and again between October and November.

In the next parallel, viz., between 15° and 20°, these particulars are much modified, those stations situated to the west being of higher temperature in winter, and differing but little from each other in the summer. In latitudes exceeding 20° the effect of longitude seems to be small, the western stations being of somewhat higher temperature.

Formulæ for calculating the mean temperature of places situated south of 15° of north latitude, in the presidency of Madras, at moderate elevations.

Formulæ for calculating mean temperature.

January -	$76° - (\text{lat.} - 13\frac{1}{2}) \times 1·0 - (\text{long.} - 79) \times 0·7$
February -	$79 - (\text{lat.} - 13\frac{1}{2}) \times 0·8 - (\text{long.} - 79) \times 0·7$
March - -	$82 - (\text{lat.} - 13\frac{1}{2}) \times 0·5 - (\text{long.} - 79) \times 0·7$
April - -	$85 - (\text{long.} - 79) \times 0·2$
May - -	$87 + (\text{lat.} - 13\frac{1}{2}) \times 0·3 + (\text{long.} - 79) \times 0·3$
June - -	$86 + (\text{lat.} - 13\frac{1}{2}) \times 0·4 + (\text{long.} - 79) \times 0·8$
July - -	$83 + (\text{lat.} - 13\frac{1}{2}) \times 0·3 + (\text{long.} - 79) \times 1·2$
August -	$83 + (\text{lat.} - 13\frac{1}{2}) \times 0·2 + (\text{long.} - 79) \times 1·2$
September -	$82 + (\text{lat.} - 13\frac{1}{2}) \times 0·1 + (\text{long.} - 79) \times 0·8$
October -	$81 - (\text{lat.} - 13\frac{1}{2}) \times 0·2 + (\text{long.} - 79) \times 0·3$
November -	$78 - (\text{lat.} - 13\frac{1}{2}) \times 0·5 - (\text{long.} - 79) \times 0·2$
December -	$77 - (\text{lat.} - 13\frac{1}{2}) \times 1·1 - (\text{long.} - 79) \times 0·7$

Formulæ for calculating the mean monthly temperature at places situated in India, between the parallels of 15° and 20° of north latitude, at moderate elevations.

January -	$70° - (\text{lat.} - 21) \times 1·0 - (\text{long.} - 72) \times 0·3$
February -	$73 - (\text{lat.} - 21) \times 0·8 - (\text{long.} - 72) \times 0·3$
March - -	$80 - (\text{lat.} - 21) \times 0·5 - (\text{long.} - 72) \times 0·3$
April - -	$85 - (\text{long.} - 72) \times 0·3$
May - -	$89 + (\text{lat.} - 21) \times 0·4 - (\text{long.} - 72) \times 0·1$
June - -	$87 + (\text{lat.} - 21) \times 0·3$
July - -	$87 + (\text{lat.} - 21) \times 0·3$
August - -	$83 + (\text{lat.} - 21) \times 0·2 - (\text{long.} - 72) \times 0·1$
September -	$82 + (\text{lat.} - 21) \times 0·1 - (\text{long.} - 72) \times 0·2$
October -	$81 - (\text{lat.} - 21) \times 0·2 - (\text{long.} - 72) \times 0·2$
November -	$77 - (\text{lat.} - 21) \times 0·5 - (\text{long.} - 72) \times 0·2$
December -	$72 - (\text{lat.} - 21) \times 1·1 - (\text{long.} - 72) \times 0·3$

Formulæ for calculating the mean temperature of places situated in India, between the parallels of 20° and 25° of north latitude, at moderate elevations.

January -	$70° - (\text{lat.} - 21) \times 1·0 - (\text{long.} - 72) \times 0·2$
February -	$73 - (\text{lat.} - 21) \times 0·8 - (\text{long.} - 72) \times 0·1$
March - -	$80 - (\text{lat.} - 21) \times 0·5 - (\text{long.} - 72) \times 0·1$
April - -	$85 - (\text{long.} - 72) \times 0·1$
May - -	$89 + (\text{lat.} - 21) \times 0·4 - (\text{long.} - 72) \times 0·2$
June - -	$87 + (\text{lat.} - 21) \times 0·3 - (\text{long.} - 72) \times 0·1$
July - -	$87 + (\text{lat.} - 21) \times 0·3 - (\text{long.} - 72) \times 0·1$
August - -	$83 + (\text{lat.} - 21) \times 0·2 - (\text{long.} - 72) \times 0·1$
September -	$82 + (\text{lat.} - 21) \times 0·1 - (\text{long.} - 72) \times 0·1$
October -	$81 - (\text{lat.} - 21) \times 0·2 - (\text{long.} - 72) \times 0·1$
November -	$77 - (\text{lat.} - 21) \times 0·5 - (\text{long.} - 72) \times 0·1$
December -	$72 - (\text{lat.} - 21) \times 1·1 - (\text{long.} - 72) \times 0·2$

Formulæ for calculating the mean temperature in India north of 25° of north latitude, at moderate elevations.

January -	$63° - (\text{lat.} - 26) \times 1·0 - (\text{long.} - 81) \times 0·1$
February -	$69 - (\text{lat.} - 26) \times 0·8 - (\text{long.} - 81) \times 0·1$
March - -	$76 - (\text{lat.} - 26) \times 0·5 - (\text{long.} - 81) \times 0·1$
April - -	$85 - (\text{long.} - 81) \times 0·1$
May - -	$91 + (\text{lat.} - 26) \times 0·3 - (\text{long.} - 81) \times 0·1$
June - -	$91 + (\text{lat.} - 26) \times 0·4 - (\text{long.} - 81) \times 0·2$
July - -	$87 + (\text{lat.} - 26) \times 0·3 - (\text{long.} - 81) \times 0·3$
August - -	$85 + (\text{lat.} - 26) \times 0·2 - (\text{long.} - 81) \times 0·2$
September -	$84 + (\text{lat.} - 26) \times 0·1 - (\text{long.} - 81) \times 0·1$
October -	$79 - (\text{lat.} - 26) \times 0·2 - (\text{long.} - 81) \times 0·1$
November -	$71 - (\text{lat.} - 26) \times 0·5 - (\text{long.} - 81) \times 0·3$
December -	$63 - (\text{lat.} - 26) \times 1·1 - (\text{long.} - 81) \times 0·2$

Influence of elevation on mean temperature of the air in India.

Observed Decrease of Mean Monthly Temperature of the Air, with Increase of Elevation.

Months.	Presidency, Number of Stations, and Mean Elevation.															
	Bombay. Mean of 9 Stations, 1,373 ft.	Madras. Mean of 3 Stations, 1,584 ft.	Bombay. Mean of 3 Stations, 2,176 ft.	Madras. Secunderabad, 2,286 ft.	Madras. Bangalore, 2,874 ft.	Bengal. Cherapoongee. 3,609 ft.	Bombay. Mean of 2 Stations. 3,960 ft.	Bengal. Uttra Mullay. 4,091 ft.	Bengal. Khatmandu, 4,141 ft.	Madras. Mercara. 4,374 ft.	Madras. Wellington, 5,880 ft.	Bengal. Nynee Tal, 5,891 ft.	Bengal. Kotgurh. 6,125 ft.	Bengal. Darjeeling, 6,491 ft.	Madras. Ootacamund, 7,235 ft.	Madras. Dodabetta. 8,614 ft.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
January - -	— 1½	— 1	— 5	— 6	— 6	— 7	— 10	— 2	— 14	— 10	— 12	— 14	— 18	— 17	— 24	— 26
February - -	— 0½	— 2	— 2	— 3	— 6	— 10	— 9	— 5	— 16	— 9	— 17	— 19	— 20	— 25	— 25	— 29
March - -	0	— 2	— 3	— 2	— 3	— 14	— 9	— 9	— 17	— 9	— 16	— 20	- -	— 24	— 23	— 27
April - -	— 1	— 2	— 2	— 1	— 6	— 17	— 11	— 17	— 18	— 12	— 21	— 23	- -	— 29	— 22	— 29
May - -	— 2	— 2	— 4	— 2	— 7	— 21	— 16	— 24	— 20	— 14	— 18	— 24	— 25	— 33	— 25	— 29
June - -	— 4	— 5	— 6	— 6	—10	— 20	— 15	— 26	— 18	— 16	— 16	— 24	— 21	— 30	— 26	— 32
July - -	— 7	— 6	— 8	— 7	— 8	— 17	— 19	— 22	— 11	— 16	— 15	— 20	— 18	— 26	— 25	— 29
August - -	— 5	— 5	— 7	— 9	— 9	— 16	— 17	— 20	— 11	— 17	— 12	— 19	— 19	— 24	— 25	— 30
September -	— 4	— 5	— 7	— 5	— 7	— 14	— 15	— 18	— 12	— 16	— 15	— 19	— 20	— 23	— 24	— 29
October - -	— 3	— 5	— 6	— 4	— 8	— 11	— 12	— 15	— 14	— 14	— 12	— 18	— 22	— 23	— 23	— 28
November -	— 3	— 2	— 6	— 4	— 6	— 14	— 12	— 7	— 15	— 11	— 13	— 15	— 18	— 19	— 23	— 27
December -	— 2	— 1	— 7	— 6	— 7	— 12	— 12	— 2	— 15	— 14	— 9	— 9	- -	— 17	— 25	— 28

From these numbers it is very clear that there is no marked difference in the effect of elevation in different parts of India, or in other words, whatever may be the mean temperature due to the latitude and longitude on the plains, the effect of elevation is to depress this by the same amount. By looking over these numbers, the results in the summer months at Cherrapoongee seem to be too large, and those at Uttra Mullay are wholly discordant, being much too small in the winter, and much too large in the summer months.

By taking the means of these results below 2,000 feet, in one group, those between 2,000 and 3,000 feet in another, and so on, another table of mean values was formed. These were laid down on a diagram, with feet as abscissæ, and degrees of temperature as ordinates, and a curved line was made to pass through or near every point, and the value for every 1,000 feet of elevation was read from the curved line; and thus the next table was formed, giving the most probable amount of depression of temperature with elevation, that can be found from the observations.

CALCULATED Decrease of Mean Monthly Temperature of the Air with an Increase of Elevation up to 9,000 feet.

MONTHS.	Height in Feet.								
	1,000.	2,000.	3,000.	4,000.	5,000.	6,000.	7,000.	8,000.	9,000.
	°	°	°	°	°	°	°	°	°
January	1½	4	6¾	10	12¼	16½	20¾	25	28¼
February	1¾	3½	6¼	10¼	14¾	19½	24	27¼	30¼
March	1¾	3½	6½	10½	15	19	23½	26¼	29
April	2	4	8	13½	18¼	22	24¾	27½	30
May	2	5	10½	15½	19¾	23	25¾	27¾	30
June	3	6	11	15¾	19½	23	26¾	30	33
July	3½	6¾	10	13½	17	20¼	23¾	27¼	30¾
August	4¼	7½	10¾	14	17½	20¾	24¼	27¾	31½
September	3½	6½	9¾	13	16½	20	23	26	30
October	3	6	9	12½	15¾	19	22¼	25½	29
November	2¾	6	8¾	12	15	18½	21½	24¾	28
December	2	4	7¾	11¼	14¾	18½	22	25¾	29½

By the applications of these numbers the mean temperature of every month, in every place in India can be approximately determined. If the height of the place whose temperature is desired be not exactly an even 1,000 feet, the amount can be taken out at sight.

AVERAGE Increase of Elevation for a decrease of 1° of Mean Temperature.

MONTHS.	1,000. feet.	2,000. feet.	3,000. feet.	4,000. feet.	5,000. feet.	6,000. feet.	7,000. feet.	8,000. feet.	9,000. feet.
January	667	500	444	400	408	364	337	320	319
February	570	572	480	391	333	308	292	294	298
March	570	572	462	381	333	316	298	305	311
April	500	500	375	296	274	273	283	291	300
May	500	400	286	258	254	261	272	289	300
June	333	333	273	254	256	261	262	267	273
July	286	296	300	296	294	296	295	294	293
August	235	267	279	286	286	289	288	289	286
September	286	308	308	308	303	300	304	308	300
October	333	333	333	320	318	316	315	314	311
November	363	333	343	333	333	324	326	323	321
December	500	500	387	356	339	324	318	311	305

Mean monthly temperature.

Observed and Calculated Mean Monthly Temperatures of the Air, and the Difference between them, at different Stations in India, between Latitudes 12° and 31°.

Months.	Cannanore.			Madras.			Vingorla.			Bombay.			Calcutta.			Lucknow.			Ferozepore.		
	Observed.	Computed.	Difference.	Observed.	Computed.	Difference.	Observed.	Computed.	Difference.	Observed.	Computed.	Difference.	Observed.	Computed.	Difference.	Observed.	Computed.	Difference.	Observed.	Computed.	Difference.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
January - - -	82	81	− 1	76	76	0	78	75	− 3	74	72	− 2	70	65	− 5	66	63	− 3	59	59	0
February - - -	82	83	+ 1	78	78	0	79	77	− 2	76	75	− 1	75	71	− 4	68	68	0	68	66	− 2
March - - -	84	85	+ 1	80	81	+ 1	82	82	0	80	82	+ 2	83	77	− 6	79	76	− 3	76	74	− 2
April - - -	86	86	0	83	84	+ 1	83	85	+ 2	83	85	+ 2	88	84	− 4	88	85	− 3	81	85	+ 4
May - - -	85	86	+ 1	87	87	0	85	87	+ 2	86	88	+ 2	89	88	− 1	91	91	0	94	93	− 1
June - - -	80	82	+ 2	87	86	− 1	81	85	+ 4	83	86	+ 3	87	88	+ 1	90	90	0	95	95	0
July - - -	79	78	− 1	85	84	− 1	79	85	+ 6	81	86	+ 5	85	85	0	88	87	− 1	90	90	0
August - - -	79	78	− 1	84	84	0	79	82	+ 3	81	82	+ 1	85	83	− 2	84	85	+ 1	86	87	+ 1
September - -	79	79	0	84	83	− 1	79	81	+ 2	80	82	+ 2	85	82	− 3	85	84	− 1	86	85	− 1
October - - -	81	80	− 1	82	82	0	81	82	+ 1	82	82	0	84	79	− 5	79	79	0	79	79	0
November - - -	82	80	− 2	79	79	0	79	80	+ 1	79	79	0	78	72	− 6	70	70	0	68	69	+ 1
December - - -	81	82	+ 1	77	78	+ 1	78	78	0	76	74	− 2	72	65	− 7	60	62	+ 2	58	59	+ 1

By looking over the several columns of differences, it will be seen that those at Cannanore and Madras are small, and therefore that the calculated and observed values are very nearly accordant; at Vingorla and Bombay, the calculated values at somewhat too high in the summer months, a difference owing to some extent to the direct influence of the sea; at Calcutta the calculated numbers in the winter are too small; at the remaining two stations, viz., Lucknow and Ferozepore, the differences are generally small.

Upon the whole, however, the accordances are as good as could be expected, considering that the observations upon which the calculations are based are not equally good, in fact in some cases suspicion reigned over the observations, but there was not sufficient evidence to reject them, and where erroneous they have exercised an injurious influence over the results. It seems to me upon the whole that they are sufficiently near for the purposes of the Commission, and more to be depended upon than any observations taken at any place for a short period, or where no information is given as to the character of the instruments, their position, or care and regularity in making the observations.

It now becomes necessary to determine those elevations, in the different parallels of latitude, where European troops could be placed with the greatest probability of continued health. These localities would be those whose meteorological conditions, particularly in temperature, approached most nearly those of England.

The following are the average value of meteorological elements as deduced from 20 years' observations at the Royal Observatory at Greenwich:

Monthly Means of Results for Meterorological Elements at the Royal Observatory, Greenwich, in the Years 1841–1860.

1841 to 1860. Months.	Mean reading of the Barometer.	Temperature of the Air.							Mean Temperature of Dew-point.	Hygrometrical Deductions.					Rain.	
		Highest in Years.	Lowest in Years.	Range in Month.	Mean of all the Highest.	Mean of all the Lowest.	Mean daily Range.	Mean Temp.		Mean Elastic Force of Vapour	Mean weight of Vapour in cubic foot of Air.	Mean additional weight required for saturation.	Mean degree of Humidity.	Mean weight of a cubic foot of Air.	Number of Rainy Days.	Amount collected on Ground.
	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.		in.
January -	29·757	57·0	4·0	53·0	43·2	33·7	9·5	38·3	35·4	·205	2·4	0·3	89	553	11	1·8
February	29·787	62·3	7·7	54·6	44·7	33·2	11·5	38·4	34·4	·201	2·3	0·4	85	554	10	1·6
March -	29·793	71·5	13·1	58·4	50·0	35·3	14·7	41·7	36·4	·216	2·5	0·6	82	550	$10\frac{1}{3}$	1·5
April -	29·735	79·0	25·3	53·7	56·8	38·6	18·2	46·3	39·9	·247	2·9	0·8	79	542	$10\frac{1}{2}$	1·8
May -	29·762	86·2	28·3	57·9	64·4	44·2	20·2	52·8	45·5	·300	3·4	1·1	76	538	$11\frac{1}{4}$	2·1
June -	29·793	94·5	36·2	58·3	71·2	50·2	21·0	59·2	50·8	·373	4·2	1·5	74	531	$10\frac{3}{4}$	1·9
July -	29·804	93·3	38·9	54·4	73·8	53·2	20·6	61·9	53·9	·417	4·6	1·6	76	528	$11\frac{1}{2}$	2·7
August -	29·788	92·0	40·0	52·0	72·8	53·4	19·4	61·3	54·1	·422	4·7	1·5	77	528	11	2·4
September	29·829	86·4	32·0	54·4	67·4	48·9	18·5	56·9	51·1	·382	4·2	1·0	81	534	$11\frac{1}{2}$	2·4
October -	29·690	81·0	26·5	54·5	58·3	43·7	14·6	50·2	46·0	·312	3·6	0·6	87	539	$13\frac{1}{7}$	2·8
November	29·756	66·3	19·4	46·9	49·3	37·7	11·6	43·4	40·1	·255	2·9	0·4	89	547	$12\frac{1}{2}$	2·4
December	29·805	62·8	8·0	54·8	45·0	35·5	9·5	40·1	36·9	·221	2·6	0·4	89	552	$11\frac{2}{3}$	1·9
Means -	29·775	77·6	23·2	54·4	58·0	42·3	15·7	49·2	43·7	·296	3·3	0·8	82	541	122	25·3

Comparison of English and Indian climates.

Excess of Mean Temperature in India over that at Greenwich.

Months.	Mean Temperature of Air at Greenwich.	Excess of Mean Temperature over that at Greenwich.									
		Latitudes.									
		South of 15°	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	°	°	°	°	°	°	°	°	°	°	°	°
January - -	38	38	35	33	31	29	27	25	23	21	19	17
February -	38	41	37	35	34	34	33	31	29	28	26	25
March - -	42	40	38	38	37	36	35	34	33	33	31	30
April - -	46	39	37	37	37	39	39	39	39	39	39	39
May - -	53	34	33	34	37	36	36	37	38	39	40	40
June - -	59	27	26	27	28	30	31	31	32	35	35	36
July - -	62	21	23	24	25	24	24	24	25	27	28	28
August - -	61	22	20	20	22	23	24	24	24	26	26	27
September -	57	25	22	24	24	26	26	27	27	28	27	28
October -	50	31	30	30	29	30	29	29	29	29	28	27
November -	43	36	35	35	34	30	29	28	27	27	26	25
December -	40	37	35	33	31	27	25	23	21	20	17	15

Height in Feet at different Parallels of Latitude in India, in every Month where the Mean Temperature is the same as that of England.

Months.	Elevation in Feet in India necessary to have the same Mean Temperature as in England.										
	Latitude.										
	South of 15°	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
January -	12,100	11,200	10,500	9,900	9,300	8,600	8,000	7,300	6,7	6,100	5,400
February -	12,200	11,000	10,400	10,100	10,100	9,800	9,200	8,600	8,300	7,700	7,500
March -	12,400	11,800	11,800	11,500	11,200	10,900	10,600	10,300	10,300	9,600	9,300
April -	11,700	11,100	11,100	11,100	11,700	11,700	11,700	11,700	11,700	11,700	11,700
May - -	10,200	9,900	10,200	11,100	10,800	10,800	11,100	11,400	11,700	12,000	12,000
June -	7,400	7,100	7,400	7,600	8,200	8,500	8,500	8,700	9,500	9,600	9,800
July - -	6,100	6,700	7,000	7,300	7,000	7,000	7,000	7,300	7,900	8,200	8,200
August -	6,360	5,700	5,700	6,300	6,600	6,900	6,900	6,900	7,400	7,400	7,700
September	7,500	6,600	7,200	7,200	7,800	7,800	8,100	8,100	8,400	8,100	8,400
October -	9,600	9,300	9,300	9,000	9,300	9,000	9,000	9,000	9,000	8,700	8,400
November	11,600	11,200	11,200	10,900	9,600	9,300	9,000	8,700	8,700	8,300	8,000
December	11,300	10,700	10,100	9,400	8,200	7,600	7,000	6,400	6,100	5,200	4,600
Means -	9,900	9,400	9,300	9,300	9,200	9,000	8,800	8,700	8,800	8,600	8,400

From these numbers it seems necessary that the heights above the sea should be different in the different seasons, as well as in the different latitudes, to obtain the same approximate mean temperature month by month, as would be obtained in England.

Excess of High Day Temperature in India in every Month over English High Day Temperature.

Months.	Mean Maximum Temperature of the Air at Greenwich.	Excess of Maximum Temperature of the Air over that at Greenwich. Latitudes.									
		16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	°	°	°	°	°	°	°	°	°	°	°
January - -	43	39	37	36	34	32	31	29	28	26	25
February - -	45	42	40	39	35	33	32	30	29	28	27
March - - -	50	40	39	38	37	36	35	35	34	33	33
April - - -	57	36	36	36	36	36	36	36	37	37	37
May - - -	64	31	32	32	33	33	34	34	35	35	36
June - - -	71	22	23	23	24	25	26	26	27	28	29
July - - -	74	16	17	17	17	18	19	19	20	21	22
August - - -	73	14	15	15	16	16	16	16	17	18	19
September - -	67	19	19	20	21	21	22	22	22	23	23
October - -	58	28	29	29	29	29	29	29	30	30	30
November - -	49	36	35	34	32	31	30	30	29	29	28
December - -	45	39	37	35	32	30	27	25	23	21	18

Height in Feet at different Parallels of Latitude in India, in every Month where the Mean Maximum Temperature is the same as that of England.

Months.	Latitudes.									
	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
January - -	11,000	10,400	10,100	9,500	9,000	8,700	8,200	8,000	7,500	7,300
February - -	10,200	9,700	9,400	8,700	8,200	8,000	7,600	7,400	7,200	7,000
March - - -	9,000	8,800	8,600	8,500	8,300	8,100	8,100	8,000	7,800	7,800
April - - -	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,400	7,400	7,400
May - - -	6,400	6,500	6,500	6,700	6,700	6,800	6,800	6,900	6,900	7,000
June - - -	4,800	5,000	5,000	5,200	5,400	5,600	5,600	5,800	6,000	6,200
July - - -	3,600	3,900	3,900	3,900	4,100	4,400	4,400	4,600	4,800	5,000
August - - -	3,900	4,100	4,100	4,500	4,500	4,500	4,500	4,800	5,000	5,300
September - -	5,600	5,600	5,800	6,100	6,100	6,300	6,300	6,300	6,600	6,600
October - - -	7,500	7,700	7,700	7,700	7,700	7,700	7,700	8,000	8,000	8,000
November - -	10,300	10,100	9,800	9,300	9,100	8,800	8,800	8,600	8,600	8,300
December - -	14,000	13,400	12,700	11,400	10,600	9,400	8,600	7,800	7,000	5,900
Means - -	7,800	7,700	7,600	7,400	7,200	7,100	7,000	7,000	6,900	6,800

These heights follow closely, but are less than those required for Mean Temperature.

Mean Monthly Low Night Temperature of the Air in India, for every Two Degrees of Latitude, in Longitude 80°.

Months.	Latitudes.									
	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	Longitudes.									
	80°	80°	80°	80°	80°	80°	80°	80°	80°	80°
January - -	69°	66°	63°	60°	57°	54°	52°	49°	46°	43°
February - -	70	68	66	65	63	60	58	55	53	51
March - -	75	74	72	70	68	66	64	62	60	58
April - -	80	79	78	77	76	75	74	72	71	70
May - -	82	82	81	81	81	81	81	81	81	81
June - -	82	82	82	83	83	83	83	83	83	83
July - -	81	81	81	82	82	82	82	82	82	82
August - -	79	79	79	79	79	79	79	79	79	79
September - -	78	79	79	79	79	79	79	79	79	79
October - - -	77	76	75	74	73	72	71	70	69	67
November - -	72	70	63	65	63	61	59	57	55	53
December - -	68	65	63	61	59	56	54	51	49	47
Mean annual low night temperature of the air -	76	75	74	73	72	71	70	68	67	66
Difference between hottest and coldest months -	14	17	19	23	26	29	31	34	37	40

Excess of Low Night Temperature in India, in every Month, over English Low Night Temperature.

Months.	Mean Minimum Temperature of the Air at Greenwich.	Excess of Minimum Temperature over that at Greenwich.									
		Latitudes.									
		16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
January - - -	34°	35°	32°	29°	26°	23°	20°	18°	15°	12°	9°
February - -	33	37	35	33	32	30	27	25	22	20	18
March - - -	35	40	39	37	35	33	31	29	27	25	23
April - - -	39	41	40	39	38	37	36	35	33	32	31
May - - -	44	38	38	37	37	37	37	37	37	37	37
June - - -	50	32	32	32	33	33	33	33	33	33	33
July - - -	53	28	28	28	29	29	29	29	29	29	29
August - - -	53	26	26	26	26	26	26	26	26	26	26
September - -	49	29	30	30	30	30	30	30	30	30	30
October - - -	44	33	32	31	30	29	28	27	26	25	23
November - -	38	34	32	30	27	25	23	21	19	17	15
December - -	36	32	29	27	25	23	20	18	15	13	11

Height in Feet at different Parallels of Latitude in India, in every Month, where the Mean Minimum Temperature is the same as that of England.

Months.	Latitudes.									
	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
January - -	17,000	15,500	14,000	12,500	11,000	9,500	8,500	7,000	5,600	4,200
February - -	12,200	11,500	11,000	10,700	10,000	9,200	8,600	7,600	7,000	6,400
March - -	13,100	12,900	12,200	11,600	11,000	10,400	9,800	9,200	8,500	7,900
April - -	10,800	10,600	10,300	10,000	9,800	9,600	9,300	8,800	8,600	8,400
May - -	8,500	8,500	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300
June - -	8,400	8,400	8,400	8,700	8,700	8,700	8,700	8,700	8,700	8,700
July - -	8,000	8,000	8,000	8,300	8,300	8,300	8,300	8,300	8,300	8,300
August - -	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300
September - -	8,600	8,800	8,800	8,800	8,800	8,800	8,800	8,800	8,800	8,800
October - -	10,700	10,300	10,000	9,700	8,900	9,000	8,700	8,300	8,000	7,300
November - -	13,600	12,800	12,000	10,800	10,000	9,600	8,400	7,600	6,800	6,000
December - -	13,400	12,200	11,400	10,600	9,800	8,200	7,800	6,600	5,800	5,000
Means - -	11,000	10,700	10,200	9,900	9,500	9,000	8,600	8,100	7,700	7,300

These heights are greater than those required to obtain English high day temperature in all cases, and much greater than required for English mean temperature at places situated south of 26°; very nearly the same at 28°, and are less at higher latitudes.

Hygrometrical state of the air in India.

The trustworthy observations for determining the hygrometrical states of the atmosphere are but few in number. This is to be regretted, as the more or less moisture in the air exercises a very considerable influence upon the health of man. The observations which I have found available have been those of the dry and wet-bulb thermometers, and no direct determination of the temperature of the dew point has been met with, made either by Daniell's or Regnault's hygrometers. Our knowledge of the laws of the distribution of water in the atmosphere is so limited, that at all elevated places some direct observations of this element should be taken, and not trust entirely to the inferential results derivable from the dry and wet bulb alone. At moderate elevations it is possibly better to use the dry and wet thermometers than either of the above hygrometers; and it may prove to be so at great elevations, when sufficient simultaneous observations have been made of direct and inferential determinations.

The hygrometrical elements most desirable to be known are,—

The temperature of the dew point.

The amount of water mixed with a certain mass of air in the invisible shape of vapour.

The amount of water required to saturate a certain mass of air, and

The degree of humidity of the air.

Before treating of the observations to determine these elements, I will speak of each separately.

The temperature of the dew point, or that degree of temperature to which the temperature of the air must be reduced so that the air becomes saturated by the quantity of water mixed with it in the invisible shape of vapour.

If, therefore, the temperature of the air be higher than that of the dew point, the air is not saturated; if these temperatures be alike the air is saturated; and if the temperature should decline, some rain must fall.

The amount of water necessary to saturate a mass of air, say, one cubic foot, varies with its temperature. At 32° air is saturated by a little more than 2 grs. at 42° by 3 grs.; at 49° by 4 grains; at 56° by 5 grs.; at 61° by 6 grs.; at 66° by 7 grs.; at 70° by 8 grs.; and so on, till at about 100° the capacity of air for moisture is such that 20 grs. nearly can be held in solution before the air is saturated.

The difference between the amount of water in the air and that amount which could be in the air at that temperature shows the amount short of saturation.

The degree of humidity of the air expresses the ratio between the amount of water then mixed with it and the greatest amount possible to be held in solution at its then temperature, upon the supposition that the latter or saturated air is represented by 100 and when deprived of all moisture by 0. Thus, sup-

pose the water mixed with a certain mass of air to be one-half of the quantity which could be present in the same mass of air at its then temperature, the degree of humidity would in such a case be represented by 50, and would imply that there were present 50 hundredth-parts of the quantity of water which would then saturate the air. At the temperature of 32° the degree of humidity would be 50 when one grain of water was mixed with a cubic foot of air; whilst at 100° it would require 10 grs. to be present in the same mass of air to have the same degree of humidity.

The best series of hygrometrical observations in my possession made in India are those at the observatories of Madras and Bombay.

From these it seems that the atmosphere is least moist upon the average of the whole year about two hours after noon, but this varies at different times of the year. The most moisture in the 24 hours is at a little before six in the morning and, the air is in a mean state about 9 or 10 o'clock both in the morning and evening. The daily curve of humidity is very nearly the opposite to that of temperature, the dryest time being about 1 or 2 p.m., at about the time of maximum temperature, and the wettest about sunrise, or minimum temperature; except in the months of June and July, when the moisture is greatest about midnight; and in August and September the increase of moisture after midnight is very small.

Mean Monthly Hygrometrical Values at Madras and Bombay.

Months.	Temperature of the Dew Point.				Weight of Vapour in a Cubic Foot of Air.		Weight of Vapour required to saturate a Cubic Foot of Air.		Degree of Humidity.	
	Madras.	Bombay.	Below the Temperature of the Air.		Madras.	Bombay.	Madras.	Bombay.	Madras.	Bombay.
			Madras.	Bombay.						
	°	°	°	°	grs.	grs.	grs.	grs.		
January -	67	64	9	10	7·2	6·4	2·5	2·7	75	70
February -	68	64	10	12	7·3	6·4	3·0	3·3	71	67
March -	71	68	9	12	8·1	7·4	3·2	3·6	72	67
April -	76	73	7	10	9·4	8·6	3·0	3·4	76	72
May -	76	75	11	11	9·3	9·0	4·3	4·2	69	68
June -	73	76	14	7	8·5	9·7	4·7	2·3	64	80
July -	73	76	12	5	8·7	9·5	4·1	1·8	68	85
August -	74	74	10	7	8·9	9·1	3·5	2·2	72	80
September -	75	75	9	5	9·1	9·3	2·9	1·7	76	85
October -	74	74	8	8	8·9	8·9	2·8	2·8	76	76
November -	71	67	8	12	8·2	7·2	2·1	3·4	79	67
December -	69	64	8	12	7·5	6·4	2·5	3·3	75	67
Means -	72	71	9·6	9·3	8·4	8·1	2·6	2·5	73	74

The numbers in the second and third columns show the monthly temperature of the dew point, and those in the fourth and fifth columns its depression below the temperature of the air at Madras and Bombay respectively; this depression is generally small. It is nearly uniform throughout the year at Madras, but differs at Bombay, where it is much larger in the winter than in the summer months. The numbers in the next two columns show the very large quantity of water mixed with the air, and which is differently distributed at the two places: the numbers in the next two columns show the amount of water needed to saturate a cubic foot of air; and a great difference exists between the amount at the two places in the summer months: and the last two columns show the monthly degree of humidity.

At Madras the driest month is June, and the most humid November. At Bombay the driest period of the year is from November to May, there being but little difference in the monthly degrees of humidity in the intervening months.

A great change takes place from April to May, and the air is very humid from June, the most so in July, and continues humid till October, when a

considerable change takes place. The contrast in respect to the humidity between Madras and Bombay is very remarkable; in the summer months, at Madras the air is least moist, and is the most so in winter, while the reverse of this takes place at Bombay.

Average Hygrometrical State of the Air as deduced from 20 years' observation at the Royal Observatory, Greenwich.

Months.	Dew Point Temperature.	Weight of Vapour in a Cubic Foot of Air.	Additional Weight required for Saturation.	Degree of Humidity.
	°	grs.	grs.	
January	35	2·4	0·3	89
February	34	2·3	0·4	85
March	36	2·5	0·6	82
April	40	2·9	0·8	79
May	45½	3·4	1·1	76
June	51	4·2	1·5	74
July	54	4·6	1·6	76
August	54	4·7	1·5	77
September	51	4·2	1·0	81
October	46	3·6	0·6	87
November	40	2·9	0·4	89
December	40	2·6	0·4	89
Means	44	3·3	0·8	82

The average hygrometrical states of the air at different stations, or at small groups of stations near together, where their results have been accordant with each other, have been taken, and the general state of the moisture of the air over India will most readily be seen by glancing the eye over the following tables. At the same time their differences from England may also as readily be seen by comparing them with those of England, which are shown in the preceding table.

Hygrometrical States of the Atmosphere at different Stations, or at small Groups of Stations near together.

Months.	Dodabetta. Lat. 11° 25′ N. Long. 77° 5′ E. 8,640 feet.				Madras. Lat. 13° 6′ N. Long. 80° 21′ E.				Belgaum and Sattara. Lat. 16° 46′ N. Long. 73° 59′ E. 2,290 feet.			
	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.
	°	grs.	grs.		°	grs.	grs.		°	grs.	grs.	
January	40	2·8	1·6	64	67	7·2	2·5	75	57	5·0	3·6	58
February	50	4·1	0·3	93	68	7·3	3·0	71	56	4·9	4·9	51
March	45	3·4	1·5	70	71	8·1	3·2	72	59	5·4	5·3	50
April	50	4·1	0·9	81	76	9·4	3·0	76	60	5·6	6·1	48
May	53	4·5	0·7	87	76	9·3	4·3	69	66	6·8	4·1	61
June	51	4·2	0·3	93	73	8·5	4·7	64	68	7·5	2·0	79
July	51	4·2	0·3	93	73	8·7	4·1	68	67	7·3	1·9	80
August	51	4·2	0·3	93	74	8·9	3·5	72	69	7·4	1·2	87
September	51	4·2	0·3	93	75	9·1	2·9	76	67	7·3	1·6	80
October	51	4·2	0·3	93	74	8·9	2·8	76	63	5·2	3·0	68
November	50	4·1	0·3	93	71	8·2	2·1	79	61	5·9	3·3	64
December	47	4·6	0·6	86	69	7·5	2·5	75	57	5·2	3·2	61
Means	49	4·0	0·6	87	72	8·4	3·2	63	62	6·2	3·9	66

(*continued.*)

Hygrometrical States of the Atmosphere at different Stations—*continued.*

Months.	Bellary and Secunderabad. Lat. 17° 14′ N. Long. 77° 46′ E. 1,650 feet.				Mahableshwur. Lat. 17° 59′ N. Long. 73° 30′ E. 4,500 feet.				Dapoolee and Bombay. Lat. 18° 20′ N. Long. 73° 4′ E. 332 feet.			
	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.
	°	grs.	grs.		°	grs.	grs.		°	grs.	grs.	
January	54	4·5	5·3	47	51	4·1	3·7	53	66	6·9	2·3	75
February	56	4·8	6·2	44	47	3·5	4·5	44	67	7·2	2·6	73
March	59	5·2	8·2	39	49	3·8	5·6	40	71	8·2	2·9	73
April	64	6·4	6·9	49	53	4·3	6·0	41	75	9·5	2·9	76
May	62	5·8	7·7	45	61	5·7	4·0	59	77	10·0	3·1	76
June	67	7·0	6·2	54	66	6·9	1·4	83	73	8·7	4·0	69
July	68	7·5	3·8	66	65	6·9	0·9	88	76	9·5	1·8	85
August	69	7·4	3·8	66	65	6·8	0·5	94	75	9·3	1·6	85
September	66	7·0	4·3	62	63	6·2	1·3	83	75	9·3	1·4	87
October	66	7·0	3·6	65	64	6·6	0·9	88	73	8·7	2·4	78
November	62	6·1	3·0	67	54	4·7	2·6	64	69	7·8	2·2	78
December	57	5·0	3·6	58	53	4·4	2·9	60	64	6·4	3·0	69
Means	63	6·2	4·6	55	57	5·3	2·8	66	71	8·4	2·5	77

(*continued.*)

Months.	Poona, Dhoolia, Ahmednugger, and Seroor. Lat. 20° 27′ N. Long. 74° 48′ E. 1,613 feet.				Rajcote, Kurrachee, Deesa, and Hyderabad. Lat. 24° 28′ N. Long. 72° 16′ E. 244 feet.				Thyet Myo. Lat. 20° 18′ N. Long. 92° 46′ E. 240 feet.			
	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.
	°	grs.	grs.		°	grs.	grs.		°	grs.	grs.	
January	55	4·6	3·6	57	48	3.7	3·7	50	46	3·4	4·9	41
February	52	4·2	5·2	44	51	4·1	4·7	47	47	3·5	7·1	32
March	50	3·9	7·3	36	56	4·8	6·8	42	45	3·2	8·5	27
April	57	5·0	8·4	37	61	5·7	8·2	42				
May	63	6·3	7·0	48	69	7·3	7·8	48	69	7·4	5·4	58
June	68	7·3	4·3	64	73	8·4	6·4	57	67	7·0	4·0	63
July	70	7·8	2·5	76	75	9·0	4·5	67	75	9·4	2·3	80
August	69	7·6	2·3	78	74	8·9	3·3	73	74	8·9	2·8	76
September	69	7·7	2·1	78	71	8·1	4·0	67	75	9·1	2·9	76
October	63	6·4	3·8	63	64	6·4	5·6	53	74	9·1	2·2	80
November	55	4·8	4·5	52	50	3·9	6·1	39	65	6·6	2·8	70
December	49	3·9	4·3	48	47	3·6	4·4	46	61	5·8	3·0	66
Means	61	6·1	4·3	59	61	6·3	5·7	56	62	6·5	4·7	58

(*continued.*)

Hygrometrical States of the Atmosphere at different Stations—*continued.*

Months.	Calcutta and Fort William. Lat. 22° 34′ N. Long. 88° 25′ E.				Hazarecbaugh and Kherwarrah. Lat. 25° 21′ N. Long. 82° 18′ E. 1,550 feet.				Darjeeling. Lat. 27° 2′ N. Long. 88° 10′ E. 7,000 feet.			
	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.
	°	grs.	grs.		°	grs.	grs.		°	grs.	grs.	
January	62	5·9	2·5	69	50	4·1	3·0	58	38	2·6	0·7	77
February	64	6·4	3·5	64	54	4·5	3·8	55	41	2·9	0·5	85
March	72	8·3	3·9	68	57	4·9	4·8	50	45	3·4	0·8	80
April	76	9·5	4·3	69	60	5·4	7·2	43	48	3·8	0·9	80
May	79	10·4	3·5	75	67	7·1	6·8	55	54	4·7	0·7	87
June	81	11·0	2·6	80	66	6·8	6·8	50	59	5·6	0·4	94
July	80	10·7	1·9	85	69	7·4	5·2	60	60	5·8	0·4	94
August	80	10·8	1·5	87	75	9·3	1·7	85	60	5·8	0·4	94
September	81	11·0	1·6	87	71	8·2	2·9	74	58	5·4	0·4	94
October	76	9·7	2·4	80	63	6·3	3·4	64	49	3·9	1·3	75
November	69	7·7	2·6	75	52	4·5	3·1	59	43	3·1	1·1	74
December	61	6·0	2·6	69	53	4·5	2·2	68	40	2·8	0·5	84
Means	73	8·9	2·7	75	61	5·9	4·1	60	49	4·1	0·7	84

(*continued.*)

Months.	Benares and Meerut. Lat. 27° 8′ N. Long. 80° 30′ E. 585 feet.				Landour. Lat. 30° 27′ N. Long. 78° 10′ E. 7,000 feet.				Peshawur. Lat. 34° 20′ N. Long. 71° 2[illegible]′ E. 1,056 feet.			
	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.	Temperature of Dew Point.	Mean Amount of Vapour in a Cubic Foot of Air.	Short of Saturation in a Cubic Foot of Air.	Degree of Humidity. Saturation = 100.
	°	grs.	grs.		°	grs.	grs.		°	grs.	grs.	
January	51	4·2	2·3	65	27	1·7	1·6	49	39	2·7	1·3	67
February	54	4·7	2·6	65	32	2·1	1·1	65	43	3·1	1·4	69
March	58	5·3	4·9	55	36	2·4	2·8	45	56	4·9	1·5	77
April	58	5·1	8·5	38	41	2·9	3·9	42	66	7·0	2·4	74
May	71	8·1	6·8	54	53	4·4	3·9	53	62	6·0	6·4	48
June	77	9·7	5·8	62	57	5·1	3·7	58	72	8·1	7·2	53
July	82	11·7	2·0	86	63	6·3	1·7	78	74	8·8	6·9	56
August	75	9·5	3·1	74	64	6·6	0·9	88	74	8·9	5·5	61
September	77	10·1	2·1	82	59	5·5	1·5	78	65	6·4	6·8	49
October	73	8·8	1·3	87	46	3·4	1·8	65	56	5·0	3·5	57
November	61	5·8	2·3	72	34	2·3	1·7	57	45	3·3	2·5	58
December	51	4·2	2·0	67	29	1·8	1·5	54	39	2·7	1·3	67
Means	66	7·2	2·1	67	44	3·7	2·2	61	57	5·6	3·9	61

The places whose hygrometrical state seems to be the nearest to that of England are Dodabetta and Darjeeling. Landour, at the same elevation as Darjeeling, has the same annual temperature of the dew point, and the amount of water mixed with the air is nearly the same, but the amount of water required to saturate a cubic foot of air is three times as large as in England, and therefore the air is very much less humid than in England.

At all the other stations, the dew point is a great deal higher than in England, the water present in the air is everywhere greater, and the water required to saturate the air is also greater, so that the air is upon the whole year much less humid than in England and particularly so in the winter months.

At some stations it is also less humid all the year round, as at Madras a little less; at Bellary and Secunderabad, always much less; and at Rajcote, Kurrachee, Deesa, Hyderabad, and the country intervening and adjacent, very much less: this part of India is the least humid of any, and at the extreme northern station of Peshawur.

At other stations, such as Belgaum and Sattara, Mahableshwur, Dapoolee, Bombay, Thyet Myo, Calcutta, and adjacent country, and so up to Benares, and Meerut, the air is more humid in the summer months, and less humid in the winter months, than in England.

Upon the whole it seems that the heights ranging for the same hygrometrical states of the air as in England, differ but little if any from those ranging for the same temperature of the air as in England.

Fall of rain in India.

The most remarkable monthly rain-falls are at Mercara 55 inches in July, at Mahableshwur 92 inches in July, followed by 72 inches in August; at Malcolm Pait 72 inches in July. In the southern part of the coast rain seems to fall in every month; whilst in the northern parts, little or none falls in the months from November to April.

At west coast stations generally, between latitudes 8° N. and 25½° N., the heaviest falls occur in June and July, but chiefly in the latter month. The largest fall in the table is 92 in July at Mahableshwur, with 42 inches in the preceding and 72 inches in the following months; thus in June, July, and August, the fall at this station is no less than 221 inches. At Malcolm Pait, in the same three months, the fall amounts to 187 inches, 72 of which fell in July. At several of the other stations the amount in this month is greater than 30 inches, at a few it exceeds 40 inches, and at Mercara in July the amount is 56 inches. These amounts exceed the annual fall at the extremity of the peninsula. In contrast, the fall of rain at Kotri and Kurrachee is exceedingly small; the largest in one month was 1¼ inch at Kotri; and 1¾ inch at Kurrachee.

At these west coast stations most singular differences therefore occur, starting from Cape Comorin and Vaurioor, at the southern extremity of Madras, the fall is small amounting in the year only to 25 or 28 inches. Passing up the coast to Trevandrum the fall increases to 65 inches, to 85 at Quilon, to 105 at Cochin; then at all the stations on the coast south of 17° north latitude, the falls exceed 120 inches, excepting at Vingorla, which was about 1½ inch less, whilst at Mercara the fall was as large as 143 inches. Passing still higher up the coast the falls exceed 120 inches, till at Mahableshwur, the fall is no less than 254 inches. This station is at an elevation of 4,500 feet, in latitude 17° 59′ N. and longitude 73½° E. Still passing northwards, at Bombay the fall is decreased to 73 inches, but at Tanna a little more north the fall is as large as 105 inches. Passing still more north the fall diminishes in amount; at Baroda it amounts to 35 inches only, at Rajcote to 27 inches, at Ahmedabad it is 24 inches; and following the same direction, we come to the driest part of India, where scarcely any rain falls at all; at Kotri, for instance, in latitude 23° 54′ N. and longitude 68¾° E., less than 2 inches fall in the year, and at Kurrachee less than 5 inches.

We thus see that there are very remarkable discrepancies in the fall of rain on the Malabar coast, varying in amount from 28 inches at Cape Comorin, to 143 inches at Mercara; and stations situated near together give very different results, so much that no grouping of means can be taken, as applying to any extent of coast line.

At stations on the east coast up to latitude of 21½° N., the largest rain-fall in one month is 32 inches in November at Nellore; the next in order

19¾ inches at Poonamallee, also in November; and south of latitude 14° the heaviest falls of rain seem to take place in this month; whilst on the opposite coast the heaviest falls occur in July: north of this parallel viz., 14°, the heaviest falls occur in July and August; the largest of which, 14¼ inches, took place at Pooree.

Starting again from Cape Comorin, with its fall of 28 inches, and passing up the east or Coromandel coast, the fall of rain increases in amount, but to a much less extent than on the Malabar coast; at Pallamcottah it amounts to 56 inches, at about Madras to 50 inches reaching to 60 inches at Nellore; at more northern stations it varies between 34 inches and 50 inches; at Balasore, on the coast, in latitude 21½° N. and longitude 87° E., the fall amounts to 31 inches only; and at a little higher up, and inland, at Midnapore to 22¾ inches.

These falls exhibit a great contrast to the very large falls on the opposite coast, but the same wide differences in the amount collected at adjacent places are shown on this coast as was found to be the case on the western coast.

At inland stations situated between the Malabar and Coromandel coasts south of latitude 15°, rain falls generally to small amounts in every month of the year, varying in amount from 20½ inches at Combatore to 37 inches at Shenkottah. The average fall at the several stations, omitting that at Dodabetta is 28¼ inches. At Dodabetta, from two years' observations, at an elevation of 8,640 feet, the annual fall amounts to 101 inches, of which 20 fall in April, add about 12 inches in each of the last three months of the year.

By comparing the falls in this portion of the country with those at places on the adjacent coasts similarly situated with respect to latitude, we learn the following particulars:—

On the Malabar coast, with a mean longitude of about 75° 50′, the annual rain-fall varies from 105 to 143 inches, of which the greater part falls in the months from May to September.

In the central portion of the district, with a mean longitude of about 77½°, the annual fall varies from 21 to 37 inches, spread almost equally over the year.

On the Coromandel coast, with a mean longitude of about 79°, the annual fall varies from 42 to 56 inches, October and November being the wettest months.

At stations in Bombay situated between latitudes 15° 50′ and 17° 40′ N. and longitudes 74° to 77° E. The heaviest falls as in the west coast stations take place in the months of June, July, and August, but to a much less amount than in that group. The largest falls were at Belgaum; in the three months ending August the fall amounts to 31 inches, of which 15 inches were in July. The next in amount is Sattara, a station of very nearly the same elevation as Belgaum, in July nearly 12 inches fall. Within this group rain generally falls during nine months of the year, the three months December to February being nearly free from rain.

The annual fall at Belgaum is about 51½ inches, and the average of the other stations is about 30 inches.

At stations in Madras comprised between the latitudes 15° 50′ and 18° 50′ N. and longitudes 77° and 78½° E., the rain-fall is as follows:—

At Kurnool, within this group, the largest monthly fall is in July, viz. 17 inches, and in the three months ending August at the same station 40 inches, the annual fall amounting to 72 inches nearly. At Bellary and Seroor the fall is about 21 inches, whilst at Secunderabad it amounts to 34¼ inches. The mean of these three stations gives 25¾ inches, as the average fall of rain over this part of the country.

In a group of stations in Bombay between latitudes 18° and 18½° N., and longitudes 73¾°, and 74½° E., the mean annual fall of rain at the two lower stations is 24¼ inches, whilst at the third station, Poorundhur, at the height of 4,200 feet, it amounts to 72¼ inches, of which 23 inches fall in July, and nearly 50 inches in the three months ending August.

At three stations between the latitudes 19½° and 21° N. and longitudes 73¾° and 75½° E., the results differ very much, varying from 28½ inches at Nassik to three times as much at Dhoolia, viz., 83¼ inches, whilst at Aurungabad the amount is intermediate, viz., 44 inches. The mean of the three is 52¼ inches nearly. The greatest monthly fall is 21 inches, in July,

at Dhoolia; in the four months ending September the fall at this station amounts to 66 inches. At Malligaum, a station between Nassik and Dhoolia, but nearer to the latter than the former station, a small fall of rain in the year is reported to take plece, but I have been unable to obtain sufficient information to speak decidedly upon this point.

At six stations situated to the east of the last group, between the latitudes 21° and 23¼° N. and longitudes 78° and 80° E, the heaviest falls occur in July. The four wet months are June to September. The results agree pretty well together. The mean annual fall is about 40 inches.

A group of stations, between the latitudes 23½° and 25½° N. and from longitudes 69° to 75° E., includes Mount Aboo, at the height of 4,000 feet, where the fall of rain in the four months ending September amounts to 62 inches, 26 of which fall in July.

The annual fall at the other stations varies from 16 to 34 inches, and averages to 24 inches in the year. The fall at Mount Aboo in the year is 65 inches nearly, the excess of 41 inches is due its elevation.

The fall of rain at stations between latitudes 20° and 27½° N. and longitudes 91¾° and 93° E. is very large, and includes that remarkable station at which, so far as I know, the heaviest falls of rain take place at any place in India, viz., Chirrapoongee, at an elevation of 4,500 feet. The fall of rain at this station in April is 22 inches, in May 62 inches, in June 195 inches, in July 121 inches, in August 103½ inches, in September 75 inches nearly, and in October 29 inches; within the seven amounting to a fall of no less than 608 inches; none falls there in November and December, and less than 5 inches in the first three months in the year. Very heavy falls take place at some of the other stations; at Akyab 59½ inches fell in June; at Sylhet the falls are very heavy, and but one month viz., November, is free from rain.

The annual fall of rain at eight other stations, omitting Sylhet and Chirrapoongee, is 78 inches; at Sylhet the fall is 210 inches, and Chirrapoongee 612½ inches in the year.

Stations situated W. of the last group, and nearly parallel to it, between latitude 23½° and 26¼° N. and longitudes 89¼° and 91¼° E., yield large falls. The falls in June are the heaviest, varying from 19 inches to 43 inches. No rain falls in the last two months of the year, and but little in the first four months. The average fall from the six stations is 93¼ inches, and for the district of country between 91¼ and 91¾ may very fairly be assumed to have a fall varying from 78 to 92 inches; and if so, the very large area of 5° of longitude and 7° or 8° of latitude, partakes of these very heavy falls.

Stations situated to the west of the last group are in the country between atitudes 22½° and 23¼° N. and longitudes 88½° and 89¼° E.

This space includes Calcutta, immediately round which rain falls heavily in the four months ending September, amounting to very nearly the annual fall. Some rain, however, seems to fall in every month at Calcutta, the average annual amount is about 60 inches. At two stations in the same longitude, a little to the N., the average annual fall is about 38 inches, and perhaps the mean fall within the above limits may be considered as about 49½ inches. At Midnapore, a station nearly in the same parallel of latitude as Calcutta, but 1½° W. of it, the fall of rain in one year 1851, was 22¾ inches only.

At four stations between latitudes 24¾° and 26¼° N. and longitudes 85° to 85½° E., the fall of rain is small, amounting to an average in the year of less than 30 inches; Uttra Mullay has a fall of 230 inches, but this increased amount is accounted for by its height of 4,600 feet. At this station rain falls in every month of the year, in October to the amount of 50 inches.

At stations between latitudes 25¼° and 23¾° N. and longitudes 87° and 88¾° E., the average fall may be considered for this part of the country as 45 inches.

Three stations, situated a little to the north and west of Calcutta, between latitudes 23¼° and 23¾° N. and longitudes 87° and 88° E., have about one-half only of the fall at Calcutta; the average annual fall is 30½ inches.

At five stations situated N.E. and W. of Calcutta, between the latitude 23½° and 24¼° N. and longitudes 85½ and 88½° E., with the exception of that from Bauliah, the extreme north station of the group, the results are accordant with each other. The heaviest monthly falls are in June and July, and the

average fall for the year from all the stations is 46½ inches. At Darjeeling, a station some degrees north of Bauliah, in latitude 22° 25′ N. and longitude 87° 19′ E., at an elevation of 7,000 feet, the fall of rain in the year amounts to 124 inches, a small amount for its elevation.

At stations between latitudes 25° and 26¾° N. and longitudes 81¾° and 83½° E., there are five wet months; the largest fall, 61¾ inches, is at Goruckpore, the mean of the five stations is 42 inches, and is probably near the truth for this part of the country.

Within the latitudes 26° and 30½° N, and longitudes 76¾° and 79¾° E. there are 12 stations, one of which, Nynee Tal, is 6,400 feet in height, and, as was to be expected, yields the largest rain-fall in the group. In the four wet months, June to September, at this station, the falls amount to 79½ inches, of which 23 inches fall in July and 29 in August. The fall for the year is 96 inches.

The station Meerut, within this group, seems remarkable for its small fall of rain, 18 inches only in the year, but this result is entitled to but little weight as the observations are for one year only, and I cannot learn anything about the position of the gauge, and the same remarks apply to Roorkee. The mean of all, excepting Nynee Tal, give 30¼ inches as the annual fall of rain for this district.

A little greater elevation than Nynee Tal, viz., 7,000 feet and situated N.E. of it, in latitude 30° 27′ N. and longitude 78° 10′ E., the annual fall of rain at Landour is 93 inches nearly.

Between the latitudes 30° 34′ and 30° 57′ N. and longitudes 74° and 78¼° E. are three stations, and the four extreme north stations are added to the group. The three stations are Mean Mear, Loodiana, and Ferozepore; rain falls in small amounts in the first nine months of the year, and none or to very small amounts in the remaining three months, the annual falls are 16¼ inches, 16½ inches, and 18¼ inches, respectively, giving a mean annual fall of 17 inches only.

In nearly the same longitude as Mean Meer, but at a little more than a degree greater north latitude, the fall at Punjab amounts to nearly 57 inches in the year, 23 inches of which fall in July.

At Meera, which is in 32° 27′ N.° and 70½ E., the annual fall of rain is 50 inches nearly, 23 inches of which fall in July.

At the two extreme north stations, viz., Rawul Pindi, in latitude 33° 34′ N. and longitude 73° 5′ E., at an elevation of 1,500 feet, the fall returned for the year 1859 was 17½ inches only; and at Peshawur, in latitude 34° 20′ N. and longitude 71 29′ E., and at an elevation of 1,056 feet, the annual fall of rain is less than 14 inches.

Remarks on the Climate of Stations.

Bengal Presidency.

Bengal Presidency.

Bengal Presidency lies between latitudes 20° and 31° N. and longitudes 74° and 91° E., and is within the basin of the Ganges. This presidency is much the largest of the three into which India is divided. It includes the districts of Assam, Cachar, Arakin, the Tennassarim provinces, and the possessions in the Straits of Malacca, as Penang, Singapore, &c.; the most southern of which reaches within one degree of the equator. The high table lands and high districts lie to the west and north. The climate presents every variety.

Singapore.

Latitude, 1° 16′ N. Longitude, 103° 53′ E. Height above sea, 30 feet.

The nearest hill of any height is Bukel Timee, 5 or 6 miles distant from the station, which is open and freely exposed to the winds. A gentle breeze almost daily moderates the heat; the land or jungle wind is the coldest; the sea breeze being sensibly warmer, and often produces lassitude, and sometimes fever.

The climate is moist, moderately hot; not variable; and is damp from the constant rain and its proximity to the sea. Dust is seldom troublesome.

BENGAL PRESIDENCY.

Penang.

Latitude between 5° 14′ and 5° 29′ N. Longitude 100° 25′ E. Height above sea a few feet.

A hill 2,500 ft. in height, is 4 miles distant. The station, is exposed to the sea breeze only, which is generally light and healthy.

It rains frequently, though not constantly, all the year round; this, with the sea air, and occasional light breezes, renders the climate decidedly good. In comparison with India generally the thermometer averages 5° or 10° less. These good effects are somewhat counteracted by the relaxing nature of the climate, owing to a powerful sun converting the moisture into steam, and to the remarkable absence of motion in the air particularly in the evening.

Mergui.

Latitude, 12° 27′ N. Longitude, 98° 42′ E. Height above sea, 200 ft.

There are hills of some height on the opposite bank of the river.

The station is open to both land and sea breezes. The former blow from May to October, and the latter during the other months of the year.

The climate is considered the best in Burmah. The air is moist and the temperature variable. The nights are always cool, and hence sleep is refreshing.

Tavoy.

Latitude, 14° 7′ N. Longitude, 98° 18′ E. Height above sea, 12 ft.

The nearest mountain is the Ox's Hump, between 30 and 40 miles east of the station, which is exposed to a sea breeze during the earlier months, and to a cold easterly land wind towards the end of the year.

Burmah. Shway Gheen, Martaban.

Latitudes, 18° 6′ N.; 16° 30′ N. Longitudes, 96° 46′ E.; 97° 40′ E. Height above sea, 125 ft.

There are mountains about 20 miles distant from the station, which is freely exposed to all winds. The sea breeze is occasionally felt.

The climate is dry only during the months of February, March, April, and the early part of May. It is very damp during the rest of the year, and being never very hot or very cold, its variability is not great. Fogs are rare. During the dry season the air is loaded with smoke and particles of burnt matter, from the jungles being on fire on all sides.

Tonghoo.

Latitude, 18° 57′ N., 40 miles from the Burmese frontier. Longitude, 96° 30′ E., 160 miles from the coast. Height above sea, 300 ft.

The nearest range of mountains are distant about 12 miles.

From November to February cold northerly land winds prevail. During the cold season dysentery cases are aggravated, and during the southerly winds fevers prevail.

The climate for a tropical one is good; from November to February the nights and mornings are cold; during the day it is dry and hot, with heavy dews at night, and fogs in the morning. From the 1st March till the end of May it is hot and sultry. From June to October close and damp. During the hot season the station is enveloped in clouds of dust.

Rangoon.

Latitude, 26° 48′ N. Longitude, 96° 10′ E. Height above sea varies from a few feet to 80 ft.

There are no mountains within 100 miles of the station, which is open and freely exposed; there are no ungenial, cold, variable, or land winds; the sea breeze blows freely at certain seasons.

The climate is dry from the middle of October until the middle of May. Heavy dews and mists prevail during January, February, and March. The day heat is excessive from March till May, but a refreshing sea breeze generally sets in about 4 p.m.; the nights and mornings are cool. The temperature usually varies about 20° in the 24 hours.

Thyet Myo.

Latitude, 20° 18′ N. Longitude, 92° 46′ E. Height above sea, 240 ft.

There is a range of small hills, 3 miles S.S.W. of the station, which is open where houses are built, but the jungle grows close up to the confines, and therefore it is not freely exposed to the winds. There is no sea breeze.

The character of the climate, as compared with Indian stations generally, is that of greater moisture of atmosphere and more clouded state of sky.

BENGAL PRESIDENCY.

The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 84° in December and 101° in April.
The low night temperature varies from 53° in January to 78° in May, August and September.
The mean annual temperature of the air is about 80°; the mean daily range 19°.
The annual fall of rain is about 48 inches, of which 17 inches fall in the month of June, and 33 inches in the three months, June, July, and August.

Cuttack.

Latitude, 20° 28′ N. Longitude, 85° 55′ E. Height above sea, 80 ft.
A range of mountains extends within 20 miles of the station, which is generally speaking fully exposed to the winds. The land wind is prevalent during the N.W., and a sea breeze during the S.W. monsoon. The latter, by modifying the temperature during the hot season, exercises a salutary effect.
The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 76° in December to 96° in May.
The low night temperature varies from 61° in December to 81° in June.
The mean annual temperature is about 79°; mean daily range 13°.

Seetabuldee.

Latitude, 21° 10′ N. Longitude 79° 9′ E. Height above sea, 939 ft.
The nearest mountain is Ramakonah, 25 miles distant from the station, which is open and freely exposed to the winds.
The climate is good. It is hot from March 15 to June 15; wet till September 30, and during the remainder of the year moderately cool.
The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 74° in December to 99° in May.
The low night temperature varies from 61° in January to 92° in May.
The mean annual temperature is about 82°; mean daily range 8°.
The annual fall of rain is about 47 in., of which 13 in. fall in June, 12½ in. in July, and 11 in. in August, making 43½ in. in the three months.

Dera Ismael Khan.

Latitude, 22° N. Longitude, 71° E.
This station is situated at the northern extremity of the Dera, and on the right bank of the Indus.
There is considerable variation of climate between the different seasons in this part of the trans-Indus country. During the warm weather, for five or six months of the year, the heat is generally intense, and of a dry character, while during the winter months, the weather is sometimes extremely cold; a sharp cutting wind blowing from the W. over the snow-covered tops of the Saliman range. The rainy season is of very short duration, and but little rain falls during the year.
The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 81° in January to 97° in June.
The low night temperature varies from 62° in January to 84° in June.
The mean annual temperature is about 80°; mean daily range 14°.

Fort William, Calcutta.

Latitude, 22° 34′ N. Longitude, 88° 25′ E. Height above sea, 18 ft.
Nearest elevation, the Rajmahal Hills, 130 miles distant.
During the cold season the prevailing N. and N.W. winds are bracing and invigorating. In the hot weather the prevailing S. and S.S.E. winds are from the sea, and their usual beneficial effect is much lower. The temperature of the station is high, but the extremes of heat are moderated by contiguity to the ocean, rivers, and lakes. The atmosphere is generally moist. The elevation of the thermometer during the hot, and depressions during the cold seasons, are not so great as up the country, and the climate is more equable though more humid.
The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 77° in December to 94° in May.
The low night temperature varies from 59° in December to 81° in June.
The mean annual temperature of the air is about 82°; mean daily range 13°.
The annual fall of rain is about 61 inches, of which 40 inches fall in three months ending August.

BENGAL PRESIDENCY.

Dum Dum.

Latitude, 22° 38′ N., 8 miles from Calcutta. Longitude, 88° 30′ E., 10 miles from Barrackpore. Height above sea, 18 ft.

Nearest mountain is Parisnath, 121 miles from the station, which, as a general rule, is not exposed to cold or variable winds, but is under the influence of the N.E. and S.W. monsoons; the latter is the sea breeze.

The climate of Dum Dum, as of all Lower Bengal, is very moist. The weather is not very cold, as in the N.W. provinces, and never so hot, dry, and trying, even in the hot season, as up the country. There is a thick mist nearly every morning, hanging over the station, for a month before the hot season commences. There is no dust at any time sufficient to render the air impure, or other admixture affecting the atmosphere unfavourably.

The temperature about Calcutta is more tropical than in several of the districts of India further south.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 72° in December to 97° in May.

The low night temperature varies from 58° in January to 82° in June and July.

The mean annual temperature of the air is about 78°; mean daily range 14°.

The fall of rain averages about 60 inches in the year.

Barrackpore.

Latitude 22° 45′ N. Longitude, 88° 23′ E.

This station is situated on the left bank of the Hooghly, 16 miles above Calcutta.

The rainy season commences generally about the 20th of June.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 72° in December to 97° in May.

The low night temperature varies from 58° in January to 82° in June and July.

The mean annual temperature of the air is about 78°; mean daily range 14°.

Raneegunge.

Latitude, 23° 35′ N., 126 miles N.W. of Calcutta. Longitude, 87° 10′ E. Height above sea, 370 ft.

Nearest mountain 30 miles distant from the station, which is open and freely exposed to the prevailing winds.

The climate is good, with no great or unusual variability, but is subject to heavy storms of sand and dust.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 71° in December to 97° in May.

The low night temperature varies from 56° in January to 82° in June and July.

The mean annual temperature of the air is 78°; mean daily range 14°.

The annual fall of rain is about 60 inches.

Hazareebaugh.

Latitude 24° N. Longitude, 85° 24′ E. Height above the sea, 1,900 feet. Elevated table land.

With the exception of the little detached hill from 300 to 600 feet high, there are no considerable mountains, or higher table-lands in the vicinity.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 72° in December to 97° in May.

The low night temperature varies from 56° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 14°.

The annual fall of rain is about 53 inches.

Berhampore.

Latitude, 24° 5′ N., 118 miles from Calcutta. Longitude, 88° 17′ E. Height above sea, 76 ft.

The Rajmahal range of hills are 40 miles distant from the station, which is exposed to land winds from the W. and N.W., from October to March, and to E. and S.E. from April to September. Squalls with rain from the N.W. frequently occur in April and May, and their effect is always beneficial.

The climate is damp. There are frequent fogs in the early mornings, especially during the cold weather. The heat is very oppressive during April, May, and June, but is often reduced for two or three days at a time, by squalls from the N.W.

The temperature of this station is recorded as low as 44° in January, but in June it is as high as 109°.

The following are the approximate mean monthly values of temperature :—

The high day temperature varies from 75° in December to 100° in June.

The low night temperature varies from 51° in January to 77° in December.

The mean annual temperature of the air is 77°; mean daily range 22°.

The annual fall of rain is about 50 inches, of which 30¼ inches fall in the three months ending August, and 11 inches in three months ending November, the wettest month is July, the rain-fall amounting to 13½ inches.

Goonah.

Latitude, 24° 39′ N. Longitude, 77° 17′ E. Height above sea, 1,800 ft.

450 miles from the sea.
192 „ „ Mhow.
179 „ „ Indore.
191 „ „ Agra.

During the hot season the wind blows from the S.W. generally; during the rainy season the S.E. is prevalent; and during the cold season, the N.W. The west wind is hot, the east wind damp, and the N.W. cold and dry. During the prevalence of the hot winds there is generally a lull from sunset to sunrise. Previous to the setting in of the rainy season calms often occur, and the heat then is oppressive.

The following are the approximate mean monthly values of temperature :—

The high day temperature varies from 76° in January to 97° in May.

The low night temperature varies from 57° in January to 83° in June.

The mean annual temperature is about 79°; the mean daily range 14°.

The annual fall of rain is about 30 inches.

Chunar.

Latitude, 25° 5′ N., 16 miles from Benares. Longitude, 83° E. Height above sea, 250 ft.

The nearest table-land is 1½ mile distant from this station, and is about 200 ft. above its level.

The fort in which the troops are mostly located, from its great elevation, is freely exposed to winds. The rest of the station is open to winds only from the river side. The station is very little exposed to cold or variable winds, or to land winds, except in the fort; it is, however, exposed to the river breeze, which is pleasant, and generally healthy; but sometimes induces colds and fevers at the termination of the rainy season.

The following are the approximate mean monthly values of temperature :—

The high day temperature varies from 76° in January to 103° in June.

The low night temperature varies from 53° in December to 81° in June.

The mean annual temperature is 80°; mean daily range 22°.

The annual fall of rain is about 50 inches; of which 36 inches fall in three months, June, July, and August.

Hameerpore.

Latitude, 25° 10′ N. Longitude, 74° 43′ E.

Distant 40 miles from Cawnpore.
„ 84 „ Lucknow.

In the hot season the weather is very sultry indeed, but tempered to a great degree by the presence of trees. Dust storms frequently occur; during the cold season the nights and mornings are sometimes very cold, fires being acceptable.

The following are the approximate mean monthly values of temperature :—

The high day temperature varies from 77° in December to 96° in June.

The low night temperature varies from 57° in January to 83° in June.

The mean annual temperature is about 79°; mean daily range 15°.

The annual fall of rain is about 30 inches.

Chirrapoongee Khasia Hills.

Latitude, 25° 14′ N. Longitude, 91° 45′ E. Height above sea, 4,118 ft.

The station is open, and freely exposed to every wind.

The climate is healthy, but the moisture is excessive during six months of the year. The temperature is equable; during the rainy and cold seasons, however, it is foggy. The air is cold and invigorating, and there is no impurity from dust.

BENGAL PRESIDENCY.

The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 58° in December to 74° in May.
The low night temperature varies from 47° in December to 68° in July.
The mean annual temperature is about 64°; mean daily range 9°.
The average fall of rain is about 613 inches, of which 490 fall in the three months ending August; the wettest month is June, the fall being about 243 inches.

Shinghotty.

This is a station on the Grank Trunk Road, for the reception of troops, passing along by bullock train.

The climate seems good for Europeans. The cool season is pleasant, and during the hot season there is always cool air at night.

Benares.

Latitude 25° 17′ N., 74 miles E. of Allahabad. Longitude, 83° 4′ E.
Height above sea, 270 ft.

The Hill fort of Rhotasgurh is on the nearest higher ground.

The station is not exposed to cold or variable winds. The prevailing winds are east and west, the latter being the more prevalent throughout the year; sudden vicissitudes are rare.

The climate of Benares, like its geographical position, is intermediate between that of Bengal and the North-western Provinces. The cold is less intense, and the heat less scorching than that of the North-west Provinces, and it is much drier than Bengal. It is not subject to sudden changes of temperature, but there are considerable diurnal alterations, especially at the commencement of the cold season. The atmosphere is generally loaded with dust during the hot westerly winds.

The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 68° in December to 98° in May.
The low night temperature varies from 59° in December to 88° in May.
The mean annual temperature is about 78°; mean daily range 7°.
The annual fall of rain is about 37 inches, of which 29 fall in the six months, April to September.

Allahabad.

Latitude, 25° 27′ N. Longitude, 81° 50′ E. Height above sea, 368 ft.

Due south from this, running east and west, are the Kymore Hills, upwards of 2,000 ft. in height. From Mirzapore, on the Ganges, a branch of this range, in some places 1,000 ft. high, is within 15 miles.

In the dry season the air is frequently heavily laden with dust, and dust storms, at times violent, occur.

The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 71° in December to 98° in May.
The low night temperature varies from 54° in January to 83° in June.
The mean annual temperature is about 78°; the mean daily range 15°.
The annual fall of rain is about 35 inches.

Jhansi.

Latitude, 25° 32′ N. Longitude, 78° 34′ E. Height above sea, 765 ft.
The surrounding country is void of vegetation and the soil rocky.
The prevalent winds are W. and S.W.
The climate is one of peculiar and intense heat.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 73° in December to 98° in May.
The low night temperature varies from 55° in January to 83° in June.
The mean annual temperature is about 79°; mean daily range 15°.
The annual fall of rain is about 35 inches.

Dinapore.

Latitude, 25° 38′ N., 375 miles from Calcutta. Longitude, 85° 1′ E.
Height above sea, 212 ft.

Nearest mountain, Burhee, distant 120 miles from the station, which is tolerably open. The prevailing winds are the east before and during the rains, April to September, and the west for the rest of the year.

The climate is generally a medium one, between the damp of Bengal and the drought of the N.W. provinces. It is tolerably dry in the cold weather, yet not so much as to wither up the grass; neither is the heat in April, May, and June, nor the cold in November, December, and January, so great as in the

north-west. It is tolerably free from dust, and moderately variable only. Fog occasionally in November and December.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 69° in December to 98° in May.

The low night temperature varies from 53° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 15°.

The annual fall of rain is about 30 inches.

Ghazeepore.

Latitude, 25° 49′ N. Longitude, 80° 48′ E.

The station lies on the banks of the Ganges.

The nearest mountain range is the Kyanore, 70 miles from the station, which is open. The wind varies much between the E., N.W., and W. The station is quite out of the influence of the sea breeze.

The climate is not very variable; the cold season is bracing. During the hot season, when the wind is from the W., it is dry and hot, and there is much dust in the air.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 74° in December to 105° in May.

The low night temperature varies from 56° in December to 83° in July.

The mean annual temperature is about 82°; mean daily range 20°.

The annual fall of rain is about 47 inches.

Lucknow, Roy Bareilly, Fyzabad, Gondah, Seetapore.

Latitudes, 26° N. Longitudes, 81° E. Heights above sea, 360 ft. about.

The distance of Lucknow from the nearest hills is 100 miles; Roy Bareilly, 150 miles; Fyzabad, 70 miles; Gondah, 50 miles; and Seetapore, 70 miles.

The climate of the provinces, as in most other parts of India, is divisible into the cold, hot, and rainy seasons. The cold season sets in at the beginning of October, and is at its height in December, when the night temperature is low enough to freeze water. Ice is also made in January, and sometimes even so late as towards the end of February. The cold season ends in March. Heavy dew often falls in the winter months, and there are not unfrequent showers of rain. The hot season sets in towards the end of April, and hot winds blow throughout May and June till the rains commence, which they commonly do at the end of June. During this season dust storms are frequent, and often very violent, and while it lasts the air in the day is more or less charged with fine dust.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 66° in December to 100° in May.

The low night temperature varies from 53° in January to 82° in June and September.

The mean annual temperature is about 79°; mean daily range 16°.

The annual fall of rain averages from 30 to 40 inches.

Goruckpore.

Latitude, 26° N. Longitude, 82° E.

Contiguous on the west to the Oude territory.

The hot westerly winds, which are generally so prevalent in the more westerly stations in April, May, and June, seldom occur at Goruckpore.

From its proximity to the lower range of the Himalaya, much rain usually falls in this district; the fall, however, is not confined to the regular rainy season of other stations, as there is rain throughout the year, though in greater abundance during the season from June to September.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 71° in December to 98° in May.

The low night temperature varies from 53° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 15°.

The annual fall of rain is about 62 inches.

Morar.

Latitude 26° 15′ N., 75 miles from Agra. Longitude, 78° E.

The hot westerly wind generally commences here in April, at first blowing only during the day, but afterwards continuing during the greater part of the night. Frequent dust storms occur during this season of the year, accompanied with rain, hail, and thunder; they come on suddenly, and though severe are but of short duration. The hot winds cease about the middle of June, and are

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succeeded by the rains, which continue till September, the average annual fall being 50 inches.

The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 73° in December to 98° in May.
The low night temperature varies from 54° in January to 83° in June.
The mean annual temperature is about 79°; mean daily range 15°.
The annual fall of rain is about 50 inches.

Seepree.

Latitude, 26° 21′ N. Longitude, 84° 30′ E. Height above sea, 1,700 feet. 70 miles south of Gwalior, on the high road from Agra to Bombay.

The station is open on all sides. The prevailing winds are,—in the cold season, N.W.; in the hot season, W.; and in the rainy season, S.E.; but variable.

The climate of Seepree is good; cool and pleasant throughout the year; while Morar is parched and dried up, excessively hot, and requiring punkahs night and day. Seepree is green and fresh to a degree seldom seen in India, and so cool that a punkah is seldom required.

The following are the approximate mean monthly values of temperature:—
The mean high day temperature varies from 70° in December to 97° in May.
The mean low night temperature varies from 53° in January to 83° in June.
The mean annual temperature is about 78°; mean daily range, 15°.
The annual fall of rain is about 35 inches.

Kherwarrah.

Latitude, 26° 42′ N. Longitude, 79° 12′ E. Height above sea, 1,200 ft.

The nearest mountain is the Kummulnath, about 30 miles distant from the station, which is open, and much exposed to land winds, but not immediately to the sea-breeze. The land wind from the east is unhealthy.

During March, April, May, and till the 20th June, the climate is hot and dry; from the 20th June till the 20th September, the temperature is lower, more equable, and the air loaded with exhalations; from the 20th of September to the 20th of November the vicissitudes are of daily occurrence. The air is cold, the weather variable, and fogs prevail.

The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 74° in January and December to 103° in May.
The low night temperature varies from 52° in December to 84° in May.
The mean annual temperature is about 78°; mean daily range 18°.
The annual fall of rain is about 27 inches; of which, 20 fall in the three months, June to August; 12 inches fall in the month of July.

Shahjehanpore.

Latitude, 27° N. Longitude, 80° E.

This station is situated between the provinces of Rohilcund and Oude.

The N. and E. winds often blow for weeks together in the hot season. They are very unhealthy from blowing over an extent of jungle.

The climate is fitful, and the rains are less prolonged and regular than at other stations.

The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 71° in December to 98° in May.
The low night temperature varies from 53° in January to 83° in June.
The mean annual temperature is about 78°; mean daily range, 16°.
The annual fall of rain is about 32 inches.

Darjeeling.

Latitude, 27° 2′ N., 36 miles from the nearest part of the plains. Longitude, 88° 18′ E. Height above the sea, 7,000 ft. to 7,600 ft.

The station is situated on the western side of a mountain, surrounded by much more elevated mountains at a considerable distance.

The station is open and freely exposed to the wind; but there is very little. It chiefly blows from the S. and S.E., and its effect is beneficial.

The climate is temperate and damp; there is much fog and mist in the rainy season.

The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 50° in January to 65° in June, August, and September.

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The low night temperature varies from 39° in December, January, and February, to 58° in July, August, and September.
The mean annual temperature is about 54°; mean daily range, 10°.
The annual fall of rain is about 124 inches.

Agra.

Latitude, 27° 11′ N. Longitude, 77° 53′ E. Height above sea, 800 ft.
Nearest mountain land is at Futterpore Seckra.
The station is not exposed to cold or variable winds.
The climate from the end of October to the beginning of April is cool, clear, and healthy; it is very hot and dry, and not unhealthy, till the end of June, when exposure to the sun must be avoided. Till the end of September it is hot and moist.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 73° in December to 98° in May.
The low night temperature varies from 53° in January to 83° in June.
The mean annual temperature is about 78°; mean daily range, 15°.
The annual fall of rain is about 28 inches.

Delhi.

Latitude, 28° 39′ N. Longitude, 77° 18′ E. Height above sea, 800 ft.
The climate is malarious and unhealthy for Europeans. Delhi is considered one of the hottest places in India. The hot winds blow with great fury for three or four months in the year. The rainy and cold seasons are tolerably agreeable, but all the year round it is infected with hordes of small flies, which with the dust form one of its plagues. The rains commence generally in the latter end of June, and last, with many intermissions, to the end of September, sometimes extending to November, and vary in quantity as much as in duration. In some seasons so low a quantity as 10 inches has been measured.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 70° in December, to 99° in May.
The low night temperature varies from 50° in January, to 83° in June.
The mean annual temperature is about 78°; mean daily range, 17°.
The annual fall of rain, 25 inches.

Meerut.

Latitude, 28° 59′ N. Longitude, 77° 46′ E. Height above sea, 900 ft.
Nearest mountains, Sewalek range, 70 miles from the station, which is open, and freely exposed to cold winds in the months of November, December, January, and February. There are land winds also, generally from east or west, the latter being the more prevalent and healthy.
The climate is good, being dry for a great portion of the year and not variable. Fogs are very rare. There is much dust during the dry seasons.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 69° in December to 103° in May.
The low night temperature varies from 50° in January and November to 85° in July.
The mean annual temperature is 77°; mean daily range 19°.
The annual fall of rain is about 18 inches; the rain-fall at this station is not very remarkable, it being about the quantity which falls in a dry year on the east coast of England.

Nynee Tâl.

Latitude, 29° 20′ N. Longitude, 79° 30′ E. Height above sea, 6,400 ft.
The station is in a valley in the heart of the mountains, it is perfectly open, and exposed to winds which are bracing and conducive to health.
The climate is excellent. In the rains the air is damp; but at other times it is remarkably dry and pure.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 64° in January to 83° in May.
The low night temperature varies from 28° in January to 59° in July.
The mean annual temperature is 60°; mean daily range 29°.
The annual fall of rain is about 96 inches; of which 67 fall in the three months ending with August; the wettest month is August, the fall being 29 inches.

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Roorkee.

Latitude, 29° 53′ N. Longitude, 77° 57′ E.

The Himalaya mountains are distant about 40 miles from the station, which is generally very open. A cool wind in the hot weather blows at nights from the north, and is pleasant and healthy.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 69° in December to 99° in May.

The low night temperature varies from 50° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 17°.

The annual fall of rain is about 10 inches.

Dera Ghazee Khan.

Latitude, 30° 4′ N. Longitude, 70° 54′ E. Height above sea, 200 ft.

The nearest mountains are the Sooliman range, 40 miles west of the station which is not exposed to cold or variable winds, or to land or sea breezes.

As a rule very little rain falls in the district, and the climate may be said to be dry, though the air is always more or less charged with moisture from the proximity of canals, irrigated fields, and the river Indus. For the same reason also the temperature is lower, and the air freer from dust than in other parts of the district, beyond the influence of the cultivation.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 73° in December to 99° in May.

The low night temperature varies from 51° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 18°.

The annual fall of rain is about 15 inches.

Umballa.

Latitude, 30° 23′ N. Longitude, 76° 44′ E. Height above sea, 1,050 ft.

The nearest mountain land is the Himalaya, 35 miles from the station, which is not exposed to cold or variable winds, or to the sea breeze, and the hot land winds that prevail at one season of the year, are not unhealthy.

The climate is generally a healthy one. It is dry and hot for three months of the year, moist and hot for three more, temperate for two, and cold and bracing for the remaining four. It is neither variable nor foggy; the atmosphere, however, of the entire district is more or less affected by dust from April till July.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 76° in December to 113° in June.

The low night temperature varies from 37° in January and December to 76° in June and August.

The mean annual temperature is 79°; mean daily range 39°.

The annual fall of rain is about 26 inches.

Landour (Convalescent depôt).

Latitude, 30° 27′ N. Longitude, 78° 10′ E. Height above sea, 7,000 ft.

The station is exposed to winds from the plains, and more frequently from the interior hills.

The climate of Landour, like that of most hill stations, is very moist for some months of the year, but there is no peculiarity in the nature of the atmosphere excepting that due to elevation.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 69° in December to 99° in May.

The low night temperature varies from 50° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 18°.

The annual fall of rain is about 93 inches.

Mean Meer.

Latitude, 30° 34′ N., 6 miles S.E. of Lahore. Longitude, 74° 4′ E. Height above sea, 1,128 ft.

The nearest mountain range is 100 miles distant from the station, which is remarkably open. A cold N.E. wind blows during the cold months, which augments considerably the sensation of cold.

The climate is dry. The thermometer in a northerly-covered verandah stands at 107° at 4h. p.m. in hot weather; after a dust storm the fall may be 19°. Fogs during the cold weather are rare. During the hot weather the air is loaded with dust.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 64° in January to 98° in May.

The low night temperature varies from 45° in January to 82° in June. BENGAL PRESIDENCY.
The mean annual temperature is 75°; mean daily range 19°.
The annual fall of rain is about 16 inches, of which 13¼ fall in the six months ending September.

Latitude, 30° 54′ N. Longitude, 77° 3′ E. Height above sea, 6,650 ft. *Kussowlie.*
The station of Kussowlie is situated on the lower range of the Himalayas, and is free without undue exposure to the wind, from almost every quarter.
The climate is very good, except during the S.W. monsoon.
The annual fall of rain is about 70 inches.

Latitude, 30° 55′ N. Longitude, 74° 35′ E. Height above the sea 720 ft. *Ferozepore.*
The nearest mountain is Kangra, 90 miles from the station, which is open to the land winds but no sea breeze. During the summer months frequent dust storms arise with great violence from every quarter, without rain, loading the atmosphere with dust, which on subsiding leaves the air pure, and contributes greatly to the healthiness of the station.
The climate is dry; free from any great variation. From December to March inclusive are the most healthy months, and August and September the most unhealthy. Fevers, particularly those of an intermittent kind, are the prevailing diseases, and in severe hot weather Europeans may suffer, though rarely from attacks of heat apoplexy.
Rain falls less frequently than in the generality of other stations, except those of Sinde.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 72° in January to 106° in June.
The low night temperature varies from 47° in January to 84° in June.
The mean annual temperature is 78°; mean daily range, 22°.
The annual fall of rain is about 14 inches.

Latitude, 30° 55′ N. Longitude 75° 54′ E. Height above sea, 900 ft. *Loodiana.*
Nearest mountains the Himalayan range, 70 miles N.E. of the station, which is exposed sometimes to hot land winds from the west, but most frequently from the east.
The climate is dry and the heat great from April to October. In the winter season the nights are cold, and it sometimes freezes to a slight extent. Fogs are rare. During the hot season the air is frequently laden with dust and small sand.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 69° in December to 99° in May.
The low night temperature varies from 48° in January to 83° in June.
The mean annual temperature is about 78°; mean daily range 18°.
The annual fall of rain is about 17 inches.

Latitude 31° 21′ N. Longitude, 75° 31′ E. Height above the sea, 937 ft. *Jullundur.*
The nearest mountains are 28 miles north; a broken ridge, extending for 70 miles N., and varying from 2,000 to 5,000 ft. above the level of the sea.
The station is open to all the winds that blow, and their effect upon health is good.
The climate is good, with only three months of rainy season, July, August, September; the other months are generally dry, with occasional dust and thunder-storms; the nights become cold about October.
The following are the approximate mean monthly values of temperature:—
The high day temperature varies from 70° in December to 99° in May.
The low night temperature varies from 49° in January to 83° in June.
The mean annual temperature is about 78°; mean daily range 18°.
The annual fall of rain is about 57 inches.

Latitude, 31° 40′ N. Longitude, 74° 45′. E. Height above sea, 900 ft. *Umritsir and Gobindgur*
The station is open, and freely exposed to the prevailing winds. The prevailing winds blow about N.W. and S.E.; those from the N. and W. are generally designated the hot winds, during the months of April, May, and June, and prevail generally, with occasional intervals, the whole year.

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The S.E. winds prevail in the rainy months, July, August, September, and part of October. The N.W. winds are healthy, even when the heat is excessive, and this can be easily accounted for, by the air being so dry and free from moisture. The S.E. winds are loaded with moisture, and when they begin to blow, towards the end of June, are indicative of the rainy season, and act, from this cause, on the general health, as well as being the medium through which malaria is conveyed to the lines.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 61° in January to 92° in June.

The low night temperature varies from 44° in December to 86° in June.

The mean annual temperature is about 73°; mean daily range 13°.

The annual fall of rain is about 57 inches; of which 52¼ inches fall in the six months ending September: the heaviest fall occurred in the month of July, viz., 23 inches.

Kangra.

Latitude, 32° 5′ N. Longitude, 76° 18′ E. Height above plains, 2,500 feet.

The European soldiers have had uninterruptedly good health at this station. Its situation is favourable in every way, and conducive to health, sheltered and shaded by the surrounding hills, yet in an elevated position, 2,500 feet above the level of the plains, and open to the snowy range of the Kooloo hills, from which cool breezes blow at night time nearly all the year round.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 68° in December to 99° in May.

The low night temperature varies from 47° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 18°.

The annual fall of rain is about 25 inches.

Sealkote.

Latitude, 32° 29′ N., 63 miles N.N.E. of Lahore. Longitude, 74° 33′ E. Height above sea, 900 ft.

Nearest mountain land 30 miles from the station, which is open, and freely exposed to the winds.

The climate of this station is remarkably healthy, and suited to the European constitution; very variable, June, July, and August being very hot. Monsoon not very heavy; the cold is very great in December, January, February, and for five months of the year. The air is particularly free from dust and impurities.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 63° in January to 98° in June.

The low night temperature varies from 51° in January and February to 81° in June.

The mean annual temperature is about 75°; mean daily range 17°.

The annual fall of rain is about 29 inches.

Jhelum.

Latitude, 32° 56′ N. Longitude, 73° 47′ E. Height above sea, 1,000 feet. 100 miles N.N.W. from Lahore. 66 miles S.S.E. from Rawul Pindi.

The station is generally surrounded by high ground.

The climate appears to be a desirable one for six months of the year, from November to May. The temperature during the hot season is high, averaging from 80° to 90°, but not so oppressive as at Lahore. The station of Rawul Pindi appears for convalescents more favourable than this station.

Jhelum, is conveniently situated on the Grand Trunk road, between Peshawur and Lahore.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 68° in December to 100° in May.

The low night temperature varies from 45° in January to 83° in June.

The mean annual temperature is about 78°; mean daily range 18°.

Rawul Pindee.

Latitude, 53° 34′ N., 50 miles from Attock. Longitude, 75° 5′ E., 20 miles from Himalaya's lower range. Height above sea, 1,500 ft.

There is a range of mountains 15 miles distant from the station, which is open and freely exposed to the winds. The winds that prevail are wholesome dry winds, generally from the N.W.; the S.E. winds indicate rain.

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The climate of Rawul Pindi has been proved by 10 years' experience to be decidedly the finest in the plains of India.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 68° in December to 100° in May.

The low night temperature varies from 46° in January to 83° in June.

The mean annual temperature is about 79°; mean daily range 18°.

The annual fall of rain is about 18 inches.

Murree.

Latitude, 34° N. Longitude, 73° E. Height above sea, 7,800 feet.

The upper portion of Murree is open and freely exposed to every wind; the lower part is sheltered from N.E. and E. winds. During the winter and spring months N. and N.E. winds prevail, and their effect upon health is invigorating. During the summer months W. and N.W. winds prevail, and bring with them dense fogs and rains.

This station is a sanitarium.

Peshawur

Latitude, 34° 20′ N. Longitude, 71° 29′ E. Height above sea, 1,056 feet.

The mountain of Tarturrah, about 10 miles distant from the station, which is situated where it is freely exposed to such winds as circulate in the valley. It is not exposed to cold or variable winds, but during the cold season the wind blowing off the snow is naturally sharp, but it has no injurious effect on health.

The climate of Peshawur is exceedingly trying to weak constitutions, chiefly owing to the great changes from heat to cold and from dryness to moisture. The air is generally free from dust.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 60° in January to 102° in June.

The low night temperature varies from 44° in January to 81° in July.

The mean annual temperature is about 74°; mean daily range 19°.

The annual fall of rain is about 14 inches.

Nowshera.

Latitude, 34° 20′ N. Longitude, 73° 54′ E.

This station is nearly equidistant between Attock and Peshawur. It is situated in a valley on the right bank of the Cabul river, and is surrounded by high land.

The climate is dry and hot. It is subject to dust storms. In August 1858 the station was entirely submerged by the overflow of the Indus, causing the destruction of all the private bungalows and the native lines; from its low situation such inundations are not unlikely, either from the overflow of the Cabul or Indus rivers.

MADRAS PRESIDENCY.

MADRAS PRESIDENCY.

This presidency extends from Cape Comorin, in latitude 8° 4′ to the N. extremity of Ganjam, in latitude 20° 18′ N.; and from longitude 74° 9′ to 85° 15′ E., and is bounded N. and N.W. by the presidencies of Bengal and Bombay and the kingdoms of Nagpore and Berar.

It is in size intermediate between the two other presidencies.

Palamcottah.

Latitude, 8° 43′ N., 3 miles E. of Tinnivelly. Longitude, 77° 48′ E., 88 miles S. of Madura. Height about sea, 120 ft., 160 miles S.W. of Trichinopoly.

The nearest mountains are between 20 and 25 miles distant from the station, which being situated so near to the apex of the peninsula is exposed to winds which are, except during the very hottest months, moderately cool. The S.W. wind, which sets in towards the close of May continuing to the end of August, passes over an extensive tract of cultivated land, and is thus rendered cool, although disagreeable at times on account of its violence, and raising dust storms.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 86° in January and December to 94° in April and May.

Low night temperature varies from 76° in January to 84° in April, May and June.

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Mean annual temperature is about 81° ; mean daily range 10°.
Annual fall of rain is about 22 inches, 10 inches of which fall in September, October, November.

Trichinopoly.

Latitude, 10° 20′ N. Longitude, 77° 10′ E. Height above sea, 250 ft.
The nearest mountains are some 25 miles distant from the station, which is open and freely exposed to winds. Hot land winds blow during the months of April, May, and June, and cold N.E. winds during the monsoon.
The monthly temperature varies from 78° to 87°.
The mean annual fall of rain is about 30 inches.
There is often a dry and sultry atmosphere for months together. Whirlwinds accompanied by clouds of dust and sand, occur at short intervals in May, June, and July.

Wellington.

Latitude, 11° 5′ N. Longitude, 77° 5′ E. Height above sea, 6,000 ft.
The nearest mountain is Dodabetta, 9 miles distant from the station, which is open and freely exposed to the winds; they are from the land, principally from the N.E. and S.W.
The following are the approximate mean monthly values of temperature :—
High day temperature varies from 66° in February to 75° in August and September.
Low night temperature varies from 59° in September to 65° in May and June.
The mean annual temperature is about 62° ; the mean daily range is about 9°.
The annual fall of rain is about 31 inches.

Salem.

Latitude, 11° 39′ N., 100 miles S.E. of Bangalore. Longitude, 78° 12′ E., 170 miles S.W. of Madras. Height above sea, 800 ft.
The Shevaroy hills are 5 miles distant from the station, which is not open to any wind or to the sea breeze.

Bangalore.

Latitude 12° 57′ N. Longitude, 77° 38′ E. Height above sea, 3,000 ft.
Nundydroog, 36 miles distant from the station, which is freely exposed to winds. There is no sea breeze, and the land wind is not hot like that up the country. The winds are very dry.
The following are the approximate mean monthly values of temperature :—
High day temperature varies from 79° in January to 91° in May.
Low night temperature varies from 59° in January to 72° in May.
The mean annual temperature is about 73°; the mean daily range 16°.
The annual fall of rain is about 25 inches; 13 inches fall in June, July, and August.

Hurryhur.

Latitude, 14° 31′ N., 160 miles N.W. of Bangalore. Longitude, 75° 51′ E., 181 miles N.E. of Mangalore. Height above sea, 1,831 ft., 85 miles S.W. of Bellary.
The nearest table lands are the Babadbooder hills and Mercara, lying south by west from this station, both at a considerable distance.
The station is sufficiently open to all the prevailing winds, which generally are neither cold nor variable, and the more prevalent are from the N.E. and S.W., at the seasons respectively constituting the corresponding monsoons. There are occasionally westerly winds towards the after part of the day, which are generally agreeable, and are usually looked upon as sea breezes. The N.E. and E. winds, which usually blow in the early part of the year, are mostly hot and dry.
The climate of Hurryhur is dry, with a considerable diurnal range of temperature, especially in the cold months of the year. In all essential respects the atmosphere seems to be pure.

Ramandroog.

Latitude, 15° 8′ N. Longitude, 76° 33′ E. Height above sea, 3,400 ft.
This station is 37 miles from Bellary.
The climate is good. The station is situated under the influence of both monsoons, without suffering excessively from either; it is near enough to the

western coast to have the benefit of the sea breeze, which in the hot season moderates the temperature. It is situated on an isolated range. The wet season commences in June with the S.W. monsoon, and continues with intermissions till September. After a short interval the N.E. monsoon sets in and lasts till November, the average quantity of rain being from 34 to 40 inches. From November to February the air is clear, and easterly winds prevail. MADRAS PRESIDENCY.

Latitude, 15° 50′ N., 90 miles N.E. by E. of Bellary. Longitude, 78° 5′ E. Height above sea, 800 ft. *Kurnool.*

There is a range of small hills about 4 miles distant from the station, which is open and freely exposed to the winds.

The following are the approximate mean monthly values of temperature :—

High day temperature varies from 79° in December to 93° in April and May.

Low night temperature varies from 74° in December to 90° in April.

The mean annual temperature is about 84°; mean daily range 4°.

The annual fall of rain is about 72 inches; 40 inches of which fall in June, July, and August, 17 inches fall generally in July.

Latitude, 17° 0′ N. Longitude, 77° 0′ E. Height above sea, 1,500 ft. *Bellary.*

No table land; but about six miles from the station there is a range of small hills, and among these a peak, rising to 1,000 ft. above the station.

The station is open and freely exposed to cold E. and N.E. winds, in November, December, and January. It is also exposed to warm land winds from February to June. The rest of the year a pleasant strong W. wind generally is prevalent.

The climate is dry and temperature not very high; not being humid, the heat is bearable; range not great. No fogs. Dust storms occasionally occur, but the air is usually clear.

The following are the approximate mean monthly values of temperature :—

The high day temperature varies from 78° in January and December to 92° in May.

The low night temperature varies from 65° in February to 77° in May.

The mean annual temperature is about 75°; mean daily range 12°.

The annual fall of rain is about 22 in.; 11 in. fall in the three months ending November, of which 6 in. fall in October.

Latitude, 17° 28′ N., 6 miles N. of Hyderabad. Longitude, 78° 32′ E. Height above sea, 1,800 ft. *Secunderabad.*

The table land of Bedur is 70 miles distant from the station, which is open, and free currents of air everywhere exists. It is much exposed to cold and variable winds during and after the rainy monsoon; and when the rains have quite passed away there is an extreme dryness combined with cold, parching yet chilling the surface.

The climate may be characterized as remarkably dry. The average number of days on which rain falls is about 50. From January to June the air is dry; the first two months being cool and variable in temperature. From March to June hot land winds blow, and the heat is great. Fogs are unfrequent, and dew seldom deposited. The air is generally clear; but liable, in the hot season, to occasional dust storms.

The following are the approximate mean monthly values of temperature :—

The mean high day temperature varies from 77° in December to 95° in May.

The mean low night temperature varies from 64° in January to 82° in May.

The mean annual temperature is about 74°; mean daily range 12°.

The annual fall of rain is about 28 inches.

MADRAS PRESIDENCY.

Quilon.

Latitude, 8° 53′ N., 38 miles N.W. of Trevandrum. Longitude, 76° 39′ E., 225 miles S.E. of Cannanore. Height above sea, 40 ft., 385 miles S.W. of Madras.

The nearest mountains are the Wurrakally hills, about 12 miles distant from the station, which is open and well exposed to sea and land winds. The sea is about 250 yards distant from the station.

The effect of the climate on Europeans is renovating. During the rains, the weather is close; during the dry weather, parching but free from dust.

Cochin.

Latitude, 9° 11′ N. Longitude, 76° E. Height above sea, 40 ft.

Nearest high ground is about 30 miles distant. The hills rise to a height of 6,000 ft. above the level of the sea.

The station is exposed to cold and variable winds from the land side, during the dry season, beginning in November, about 7 p.m., and gradually becoming later, until, in February, its commencement is about 2 a.m.

The climate is variable; the breeze from the land, owing to its coming over a large expense of water, is moist and chilly. It is occasionally very sultry.

Tellicherry.

Latitude, 11° 45′ N., 95 miles S.W. of Seringapatam. Longitude, 75° 33′ E.

The Wynaad range of hills is 30 miles distant from the station, which is on the sea coast, and exposed to the sea breeze. The land wind is excluded by trees, houses, and gardens.

The climate is moist, especially during the monsoon. The hottest months are March, April, and May; but it is cooler than at most other Indian stations. The air is generally pure. The wet season, from May to September, is the most unhealthy.

Cannanore.

Latitude, 11° 52′ N. Longitude, 75° 30′ E. Height above sea, 15 ft.

The nearest mountain range is the Western Ghauts, 30 to 40 miles distant from the station.

During November, December, and January a strong land wind blows from shortly after sunset until the earth has been sufficiently heated by the sun of next day, when a current almost invariably sets in from the sea.

The climate at this station is on the whole tolerably equable, it is occasionally variable and chilly, and during the wet season it is moist and debilitating.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 82° in August to 90° in April.

The low night temperature varies from 76° in October to 82° in April.

The mean annual temperature is about 82°; mean daily range, 7°.

The annual fall of rain is about 121 inches, of which about 85 inches fall in June, July, and August.

Mercara.

Latitude 12° 24′ N., 47 miles N.E. of Cannanore. Longitude, 75° 48′ E., 130 miles S.E. of Mangalore. Height above sea, 4,500 ft., 315 miles W. of Madras.

The station is exposed to every wind that blows. The sea breeze is distinctly felt. The east wind is dreaded as parching and destroying young trees.

The climate of Mercara is excellent. The temperature during the hottest season ranging from 62° to 75°. For six months of the year it rains heavily, but the roads are dusty whenever rain is long withheld.

French Rocks.

Latitude 12° 31′ N., 5 miles N. of the River Cauvery, at Seringapatam. Longitude, 76° 45′ E. Height above sea, 2,560 ft.

There are no mountains or high lands near the station, which is exposed to variable winds, not to sea breeze.

The climate is good, being dry during eight months of the year, and somewhat moist during the monsoon. It is not very variable, and pretty free from fog or damp. There are occasional dust storms, which last but a short time.

Mangalore.

Latitude, 12° 50′ N. Longitude, 75° 0′ E. Height above sea, 40 ft., on the W. coast.

The nearest mountain is about 50 miles distant from the station, which is exposed to land and sea breezes.

Arcot.

Latitude, 12° 30′ N. Longitude, 79° 8′ E. Height above sea, 550 ft. The nearest table land is at Palamanair, 50 miles off, and about 1000 feet higher than this station.

The climate is generally a dry heat. In the monsoon and cold weather, the station is subject to fogs on the lower ground which extend on to the irrigated land. In the hot weather occasional dust storms take place.

Vellore.

Latitude, 12° 55′ N., 220 miles N. of Madura. Longitude, 79° 11′ E., 104 miles E. of Bangalore. Height above sea, 675 ft., 94 miles N.W. of Cuddalore; 79 miles W. of Madras.

The nearest hill is about ¾ of a mile from the cantonment and has an elevation of 780 feet.

The prevailing winds in February are northerly; after March S.E. winds are prevalent, they are hot during the day, but occasionally cool towards early morning. The sea breeze occasionally in the afternoon is strong, but it is generally light, or is replaced by long-shore winds direct.

This is a hot station.

Palaveram.

Latitude, 12° 58′ N., 11 miles S.W. of Madras. Longitude, 80° 15′ E. Height above sea, 40 ft.

There are no hills of any extent nearer than the Neilgherries.

The station would be open were it not for the two hills on the sea or south side, which in a great measure exclude the sea breeze or only cool wind, whereas it is quite exposed to the land or hot winds. This is one of the hottest stations in India, the thermometer seldom being below 80°, there is no cold season.

The observations of the Madras Observatory would apply here, except that the air is always much closer.

Saint Thomas' Mount.

Latitude, 13° 0′ N. Longitude, 80° 15′ E., 95 miles N. of Cuddalore. Height above sea, 60 feet, 178 miles E. of Bangalore, 10 S.W. of Madras.

St. Thomas' Mount rises close behind the barracks.

The station is exposed both to the sea breeze and land wind.

The climate is dry for at least nine months, and hot all the year round, varying from 71° to 95°. There are heavy rains during the months of October and November, and occasional showers from July till September. The average annual fall is between 30 and 40 inches. The climate is very equable; fogs are rare, the air very dusty during the dry season.

Poonamallee.

Latitude, 13° 2′ N., 13 miles due W. of Madras. Longitude, 10° 10′ E., 9 miles direct line from coast. Height above sea 2 ft.

There are hills of unknown height 40 miles distant from the station, which is open, and freely exposed to variable winds, and to land and sea breezes.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 80° in January and November to 87° in June.

Low night temperature varies from 74° in January to 82° in June, July, and August.

The mean annual temperature is about 82°; mean daily range 4°.

The annual fall of rain is about 50 inches; 30 inches of which fall in September, October, and November.

Nellore.

Latitude, 14° 20′ N. Longitude, 80° 0′ E. Height above sea, 50 ft.

The nearest mountains are 40 miles distant from the station, which is open and freely exposed to winds. The same winds prevail here as at Madras, Nellore being under the influence of the same monsoons. The long shore southerly winds in March and April are very exhausting to a European constitution.

The climate of this station is particularly dry, with little variability.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 76° in January to 93° in May.

MADRAS PRESIDENCY.

The mean annual temperature is about 82°.

The annual fall of rain is about 60 inches; 40 inches fall in September, October, and November, of which 32 inches fall in November.

Masulipatam.

Latitude, 16° 10′ N., 325 miles N.E. of Bangalore. Longitude, 81° 13′ E., 195 miles S.E. of Hydrabad. Height above sea, 7 ft., 215 miles N. of Madras.

The nearest high land is the Condapillay hills, about 55 miles distant, at an elevation of 900 to 1,000 feet above the level of the station.

The climate has the character of being salubrious. It is dry during the hot season, and damp during the monsoon, is not of a penetrating character. The heat is great at times during the hot land winds in April, May, and the early part of June. It is not subject to any great variations of temperature, but the early mornings in the month of February are distinguished by dense fogs, which are dispersed by the sun at about 8 o'clock. During the dry weather the station is subject to severe dust storms which sweep across in heavy clouds so as at times to obscure the atmosphere.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 82° in January to 95° in May.

The low night temperature varies from 68° in December to 82° in May and June.

The mean annual temperature is about 80°; mean daily range 12°.

The annual fall of rain is about 43 inches.

Guntoor.

Latitude, 16° 20′ N., 300 miles N.E. of Bangalore. Longitude, 80° 30′ E., 225 miles N. of Madras. Height above sea, 100 ft., 47 miles W. of Masulipatam.

The nearest mountain is one of a range called Kondaveed and is about 12 miles distant from the station, which is freely exposed to the winds. Sometimes during the months of November and December intensely cold winds from the N. or N.W. set in, and continue for five or six days, which cause severe colds to Europeans. The sea breeze blows pretty constantly every evening during the hotter months of the year, with a most pleasant and salutary effect. Land winds blow at times with great strength.

The climate of Guntoor may be stated to be dry, warm, and not subject to sudden variations of temperature. Fogs occasionally prevail at the end of the year. The air is quite free from dust or other impurity.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 79° in December to 94° in May and June.

The low night temperature varies from 65° in December to 84° in May and June.

The mean annual temperature of the air is about 81°; mean daily range, 10°.

The annual fall of rain is about 42 inches; 18 inches fall in the three months June, July, and August, and 15 inches in the next three months.

Samulcottah.

Latitude, 17° 4′ N., 245 miles E. of Hydrabad. Longitude, 82° 14′ E., 410 miles N.E. of Bangalore. Height above sea, 50 feet, 300 miles N. of Madras. 550 miles S.W. of Calcutta.

The hill of Dhumaverim is to the N.; it is distant 12 miles from the station, which is not exposed to cold or variable winds, the coldest being the N. which is seldom felt.

The N.E. and E. sea breezes prevail from October to January; the S.E. and S. winds from January to May; and land winds S.W. and W. by S. from May to September.

Samulcottah is moderately dry for eight months of the year, and moderately damp for the remaining four months. Unless for a few days before the S.W. monsoon there is no excessive heat, and from November to March the temperature is agreeable.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 81° in January to 96° in May.

MADRAS PRESIDENCY.

The low night temperature varies from 66° in December to 82° in May and June.

The mean annual temperature 79°; mean daily range 13°.

Vizianagram.

Latitude, 18° 7′ N., 329 miles E. of Hydrabad. Longitude, 83° 28′ E., 200 miles N.E. of Masulipatam, 438 miles S.E. of Calcutta.

The nearest mountain is Galleepareevatum, distant about 40 miles from the station, which is exposed to cold sea breezes, and land winds.

Berhampore.

Latitude, 19° 20′ N., 150 miles N.E. of Vizagapatam. Longitude, 84° 50′ E., 325 miles S.E. of Calcutta. Height above sea, 112 ft.

The nearest mountain is 8 miles distant from the station which is open and freely exposed to the winds except on the west; it is exposed to variable winds; to cold winds, November to February; to hot land winds, March to June; to S.W. winds from June to September; and to N.E. winds from the end of September to October.

The climate may be considered a dry one from March to the middle of June, the heat from April to the latter part of June being very great. In July and August the climate is variable. September, October, and November are damp months. January and February are cold and foggy. There are occasional dust storms which do not, however, render the air impure.

Jaulnah.

Latitude, 19° 50′ N., 240 miles N.W. of Secunderabad. Longitude, 75° 56′ E. 235 miles S.W. of Nagpore. Height above sea, 1,652 ft., 210 miles N.E. of Bombay.

The nearest high table land is that of Roza, 55 miles distant from the station, which is open and freely exposed, but not to cold or variable winds. The land or dry westerly winds blow during the months of March, April, May, and June. The station is too far from the sea for the breeze to reach it.

The climate is dry and cold, yet liable to great sudden variations of temperature. Fogs and damp are rare. The air is pure, rarely containing dust, &c.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 80° in January to 96° in May.

The low night temperature varies from 64° in January and December to 82° in June.

The mean annual temperature is about 80°; mean daily range, 13°.

The annual fall of rain is about 40 inches.

Kamptee.

Latitude, 21° 10′ N., 10 miles N.E. of Nagpore. Longitude, 79° 50′ E., 722 miles from Madras. Height above sea, 900 ft., 324 miles from Secunderabad, 577 miles from Bombay.

The nearest mountains are those of Chindwarra and Seonie.

The station is open to every wind that happens to blow.

The hot land winds are very distressing in May, and until the rains set in in June. The station is 400 miles distant from the sea.

The climate partakes of both heat and cold. The year is divided into three seasons, cold, hot, and rainy; transitions of which are regulated, and may be calculated at certain periods.

The cold season is from the middle of October to the middle of March; the hot season, from the middle of March to the middle of June; and the rainy season from the middle of June to the middle of October. The rainy season is preceded by distressing sultriness; and there is a considerable diurnal range of temperature in the cold season which is prejudicial to weak constitutions.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 78° in January and December to 96° in May.

The low night temperature varies from 62° in January and December to 83° in June.

The mean annual temperature is about 80°; mean daily range 15°.

MADRAS PRESIDENCY.

Hoshingabad.

Latitude, 22° 44′ N., 114 miles S.W. of Saugor. Longitude, 77° 44′ E., 428 miles S.W. of Allahabad, 144 miles E. of Mhow, 924 miles N.W. of Calcutta.

The Putchmaree hills are about 70 miles distant from the station, which is open and is not particularly exposed to cold or variable winds.

The climate is exceedingly hot, oppressive, and relaxing for the greater part of the year, and very trying to a European constitution.

The following are the approximate mean monthly temperatures of the air:—

The high day temperature varies from 78° in January to 97° in May.

The low night temperature varies from 61° in January to 83° in June.

The mean annual temperature is about 79°; mean daily range 14°.

BOMBAY PRESIDENCY.

BOMBAY PRESIDENCY.

Bombay Presidency lies between latitudes 14° and 29°, and between longitudes 66° and 77°, comprising a narrow strip of the peninsula on the W. and N.W. sides. This presidency is the smallest of the three into which India is divided. A part of the great table land of the Deccan belongs to it, and to the north of them a part of the Malwah table land bounded N.W. by the Arrawulli mountain range, which separates the basins of the Ganges and Indus. Among the hill ranges and upon the higher tracts there are many fine valleys and plains. The climate for the most part is pretty good, owing to the influence of the sea, and the extended coast, and elevated land of the interior, except in Scindia, some low tracts on the west, in the neighbourhood of Bombay, the Indus delta, and part of Guzerat.

Aden.

Latitude, 12° 45′ N. Longitude, 45° 15′ E.
Height above sea, 123 ft. (the cantonment).

There are high and lofty hills in the distance.

The station is exposed to no cold winds. With S.W. monsoon from May to September the heat is excessive. At the other seasons a fresh cool sea-breeze blows constantly.

From its vicinity to the sea the climate is equable throughout the year, and in general there is much moisture in the atmosphere. The temperature is pretty high, and the sun's rays are always very powerful. At times, especially during the hot months, clouds of dust envelop the camp.

Jacobabad.

Height above sea, 220 feet.

The nearest mountain is 60 miles distant from the station, which is perfectly open. It is exposed to fresh dry cold winds in the winter months, and in the summer to fiery hot winds.

The climate during the greater part of the year is the driest in the world. The heat in summer is excessive.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 77° in January to 109° in June.

Low night temperature varies from 44° in January to 90° in June.

Mean annual temperature is about 81°; mean daily range 27°.

Annual fall of rain is about 8½ inches.

Vingorla.

Latitude, 15° 50′ N., 215 miles S. of Bombay. Longitude, 73° 41′ E.
Height above sea, 20 feet.

A few small hills only within sight of the station; it is well exposed to the sea breeze, a compound of the west, which are the prevailing winds. The land wind, which is that from the E.N.E., is usually of short duration.

There is no considerable variation in the climate. It is never very cold, and the heat is moderate, but from heavy dews it is occasionally damp at night.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 82° in August and September, to 88° in April and May.

Low night temperature varies from 72° in January to 80° in May.

The mean annual temperature is about 85°; mean daily range 9°.

Annual fall of rain is about 118 inches; of which 41 inches fall in the month of July, and 115 inches in the six months, April to September.

Dharwar.

Latitude, 15° 50′ N. Longitude, 75° 10′ E. Height above sea, 2,482 feet. There is no mountain near the station, which is exposed to the sea breeze. The land or east wind blows from December to February.

The climate is good from November to February; it is dry and cool. There is a great deal of moisture in the air from March to June when the rains commence. From February to June the climate is generally hot by day but cool at night. The climate is never very cold; fog prevails occasionally in the mornings of the hot season.

The following are the approximate mean monthly values of temperature :—

High day temperature varies from 77° in August and September to 92° in March.

Low night temperature varies from 61° in January to 77° in May.

The mean annual temperature is about 80°; mean daily range 13°.

Annual fall of rain is about 34 inches, of which 20½ inches fall in the three months, June to August, 9·7 inches falling in August.

Belgaum.

Latitude, 15° 52′ N. Longitude, 74° 42′ E. Height above sea, 2,260 ft. 70 miles from the coast, 30 miles from Western Ghauts.

During the monsoon the wind blows from the W.; in the cold season the prevailing wind is from the E., and during the hot season from the same quarter, veering however to the W. during the latter part of the day.

The heat is greatest during April and May, but a sea breeze generally rises during the afternoon, continuing throughout the night.

The following are the approximate mean monthly values of temperature :—

High day temperature varies from 78° in August to 97° in April.

Low night temperature varies from 57° in January and December to 66° in April, May, June, and July.

The mean annual temperature is about 74°; mean daily range 23°.

Annual fall of rain is about 50 inches; about 15 inches fall in July, and 34 inches in June, July, and August.

Kulladghee.

Latitude, 16° 11′ N., 71 miles E.N.E. of Belgaum. Longitude, 75° 33′ E. Height above sea, 1,750 ft.

The nearest mountain is 50 or 60 miles distant from the station, which is open and freely exposed to winds.

The climate throughout the year may be considered tolerably good. It is dry, with the exception of the monsoon months.

The following are the approximate mean monthly values of temperature :—

High day temperature varies from 85° in December to 104° in April.

Low night temperature varies from 60° in January and December to 74° in March, April, and May.

The mean annual temperature is about 81°; mean daily range 24°.

Annual fall of rain is about 24 inches.

Kolapore.

Latitude, 16° 42′ N., 185 miles S.E. from Bombay. Longitude, 74° 18′ E., 70 miles S. of Sattara. Height above sea, 1,797 feet.

The nearest mountain is three miles distant from the station, which is open and freely exposed to the prevailing winds. They are generally strong; the land or N.E. wind blows from November to February. The sea breeze or S.W. wind commences in March, and blows during the greater part of the day and night.

During the cold season, from November to February, the climate is dry, the winds blowing generally from the N. and E.; dews fall in the early mornings, which are moist and fresh till an hour after sunrise. The climate generally is temperate, there is no severe cold during any of the seasons. The atmosphere is not rendered impure by dust, except very temporarily, and the climate is good.

The following are the approximate mean monthly values of temperature :—

High day temperature varies from 77° in January, July, August, and December to 89° in May.

Low night temperature varies from 67° in January and December to 77° in May.

The mean annual temperature is about 76°; mean daily range 9°.

Annual fall of rain is about 39 inches; 6½ inches fall in July, and 12½ inches in three months, June, July, and August.

BOMBAY PRESIDENCY.

Rutnagherry.

Latitude, 17° 0′ N. Longitude, 73° 20′ E. Height above sea, 150 ft.

The nearest mountains are the Syndree range of Ghauts, at a distance of 30 miles from the station, which is open to all winds. The heat of the summer months is moderated by fresh northerly sea breezes. The climate is damp during the monsoon, and dry in the forenoon during the prevalence of land winds from November to February. The climate may be described as generally moist, warm, and relaxing, with an annual range of about 20°, and a diurnal range not exceeding 12°. It is not affected by dust, and other admixtures affecting the atmosphere.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 84° in August to 93° in May.

Low night temperature varies from 70° in January and December to 77° in May, June, and September.

The mean annual temperature is about 81°; mean daily range 14°.

Annual fall of rain is about 127 inches; 41½ inches fall in June, and 93½ inches in June, July, and August.

Sattara.

Latitude, 17° 40′ N., 60 miles from coast. Longitude, 74° 2′ E.
Height above sea, 2,320 feet.

The fort hill is distant about 1½ mile from the station, which is open; subject to the land winds (E. and N.E.) and to the sea breeze (W.S.W.), the latter modified by distance from the ocean; both prevail with tolerable regularity, according to the season and time of day.

The climate generally considered is good for three months. The air is hot and dry, but not very exhausting. In the rains it is fresh, not damp or chilly, and the temperature very equable. The cold in the winter months is not invigorating.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 74° in August to 92° in April.

Low night temperature varies from 63° in December to 75° in April and May.

The mean annual temperature is about 76°; mean daily range 12°.

Annual fall of rain is about 38 inches; about 13 inches fall in July, 25¼ inches fall in June, July, and August.

Dapoolee.

Latitude, 17° 48′ N., 55 miles N. of Rutnagherry. Longitude, 73° 16′ E.
Height above sea, 600 feet.

The nearest table land is that of the Deccan.

The station is not exposed to cold or variable winds, nor freely to land winds, but fully to sea breezes.

The climate is divided into three seasons; 1st, the cold season, from December to the end of February; 2nd, the hot season from March till June, increasing in heat; and the third, or rainy season, from June till October. October and November are close hot months.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 80° in August to 93° in April.

Low night temperature varies from 61° in January and December to 76° in May.

The mean annual temperature is about 81°; mean daily range 18°.

Annual fall of rain is about 122 inches; 97 inches fall in June, July, and August, of which 4½ inches fall in July.

Poorundhur (Sanitarium).

Latitude, 18° 12′ N. Longitude, 73° 54′ E. Height above sea, 4,200 feet.

The climate of this station is good and equable, the monthly mean temperature of the year ranging from 60° to 80°. The year is divided into three seasons, hot, rainy or monsoon, and the cold. The hot season begins in March, and terminates about the middle of June; the station at this season is marked by the general absence of hot winds, and the almost total exemption from hot nights, a cool fresh breeze from the N.W. generally blowing from sunset to sunrise. The rainy season extends from June to October; the gloomy state of the weather, the absence of all sunshine for weeks together, combined with the impossiblity of the men taking exercise without getting wet through, tend to produce an injurious influence and great depression of

spirits. During this season one or two breaks generally occur in the weather, and continue for a week or ten days; and then it is difficult to imagine a more beautiful climate. During the cold season a strong dry wind prevails.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 68° in August to 83° in April.

Low night temperature varies from 59° in December to 71° in April.

The mean annual temperature is about 67°; mean daily range 9°.

Annual fall of rain is about 72 inches; 23 inches fall in July, and about 50 inches in the three months ending August.

Poona.

Latitude, 18° 30′ N. Longitude, 74° 0′ E. Height above sea, 1,800 feet.

The nearest mountain is Singhur, 13 miles distant from the station, which is open and freely exposed to the winds. From November to February cold land winds prevail, with occasional sea breezes; from March to June, hot, scorching, variable winds; and for the rest of the year the prevailing winds are from the sea.

The climate is good; there is almost a total freedom from fogs, and dampness is only observable during the rains, and then mild in degree. Dust storms are rare.

The following are the approximate mean monthly values of temperature:—

High day temperature varies from 78° in August to 95° in April.

Low night temperature is about 58° in January and December to 74° in May.

The mean annual temperature is about 77°; mean daily range 18°.

Annual fall of rain is about 22 inches.

Kirkee.

Latitude, 18° 30′ N., 70 miles S.E. of Bombay. Longitude, 74° 15′ E., 50 miles E. of the coast. Height above sea, 1,900 ft.

The nearest mountain is Surghur, 15 miles distant from the station, which is open and freely exposed to winds. From November to February cold land winds prevail, with occasional sea breezes; from March to June there are hot, scorching, variable winds, and for the rest of the year the prevailing winds are from the sea.

The climate is good. There is almost a total absence of fog; dampness is only observable in the rains, and then is mild in degree. Dust storms are very rare, and do not affect perceptibly the purity of the atmosphere.

Colaba.

Latitude, 18° 53′ N. Longitude, 72° 52′ E.

The climate is equable, neither so hot in summer nor so cold in winter as most other places in India. The greatest temperature noted during the 10 years, 1850 to 1860, was 97°; the lowest on record was 53°, in February 1847. January is the coolest month; December and February, somewhat less so, are much alike; then November and March; April and May are the hottest months. The monsoon months, June to September, vary little in temperature.

The land winds (S.E.) prevail during the dry season. A S.W. wind or sea breeze prevails during the monsoon months, sometimes with great strength.

The temperature of evaporation or wet-bulb thermometer increases, though irregularly, from the month of January to July, and falls from July to December. About the middle of June the sun attains its extreme southerly declination, and the rain which falls in torrents, keeps the atmosphere saturated with humidity.

In June and July the temperature of evaporation coincides with the mean annual temperature of air. The presence of clouds in the sky has the effect of increasing the temperature of evaporation.

Surat.

Latitude, 21° 10′ N., 150 miles N. of Bombay. Longitude, 72° 52′ E., 130 miles S. of Ahmedabad. Height above sea, 33 feet.

The nearest mountain is Songhur, 42 miles E. of the station.

From March to October the sea breeze prevails, and during the remainder of the year the land wind is predominant.

For about nine months in the year the climate may be said to be decidedly moist, the wind coming from the direction of the sea, which is 10 miles distant.

BOMBAY PRESIDENCY.

It is never very cold, and the temperature rises considerably, as elsewhere, during the months of April and May. There is but little if any fog in the camp, though it is sometimes observed on the other side of the river, which is a lower level. There are occasional dust storms, but, generally speaking, the atmosphere is fine.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 78° in January to 108° in May.

The low night temperature varies from 59° in January to 80° in May and June.

The mean annual temperature is about 82°; mean daily range 20°.

Baroda.

Latitude, 22° 16′ N., 68 miles S.E. of Ahmedabad, 81 miles N. of Surat. Longitude, 73° 14′ E., 166 miles W. of Mhow. Height above sea, 90 feet.

The hill fort of Powagurh, distant 26 miles, is the only high ground within sight of the station, which is so encumbered with trees, that it is not sufficiently exposed to the breeze, which blows from the direction of the sea for the greater part of the year; from November to March the land wind blows from the E. and N.E.

The climate is very damp in the rains; at other times comparatively moist. Fogs prevail till the end of November, and during the hot season winds and dust prevail; it is never very cold.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 84° in January to 105° in May.

The low night temperature varies from 56° in February to 83° in May.

The mean annual temperature is about 81°; mean daily range 21°.

The annual fall of rain is about 35 inches; about 16 inches fall in July, 30 inches generally fall in June, July, and August.

Rajcote.

Latitude, 22° 18′ N., 125 miles S.W. of Ahmedabad. Longitude, 70° 50′ E., 150 miles W. of Baroda. Height above sea, 450 feet.

The nearest mountain is the Girnar, 56 miles to the S.W. of the station, which is thoroughly open to the sea breeze, which blows steadily during eight months of the year. From November to February the winds are northerly and north-easterly.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 78° in January to 99° in May.

The low night temperature varies from 59° in January to 83° in May and June.

The mean annual temperature is about 81°; mean daily range 15°.

The annual fall of rain is about 27 inches; 21 inches fall in June, July, and August, of which 8·3 and 8·9 inches fall in July and August respectively.

Ahmedabad.

Latitude, 23° N. Longitude, 72° E. Height above sea, 320 feet.

Nearest mountain, Aboo, is 150 miles distant from the station, which is exposed to hot and cold winds from the W.S.W. and N.E.

The climate is dry except during the monsoon. Sand storms occasionally occur during the hot season.

The following are the approximate mean monthly values of temperature:—

The high day temperature varies from 78° in January to 108° in May.

The low night temperature varies from 60° in December to 86° in May.

The mean annual temperature is about 83°; mean daily range 18°.

The annual fall of rain is about 23 inches; 11 inches fall generally in July, very little rain falls during the first and last three months of the year.

Ahmednugger.

Latitude, 23° 34′ N. Longitude, 73° 1′ E. Height above sea, 1,900 ft.

The nearest hill is six miles distant, and is 617 feet elevation above the station, which generally speaking, is well exposed to the prevailing winds. It is singularly exempt from variable winds; and is freely exposed to the sea breeze, which diminishes the temperature.

The climate is dry, like that of the Deccan generally, which is attributable to the great elevation. Occasionally dust storms occur during the hot months, March, April, and May.

BOMBAY PRESIDENCY.

The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 80° in December to 98° in April and May.
The low night temperature varies from 59° in January and December to 76° in May.
The mean annual temperature is about 77°; mean daily range about 18°.
The annual fall of rain is about 25 inches.

Kurrachee.

Latitude, 24° 51′ N. Longitude, 67° 2′ E. Height above sea, 27 ft.
A low mountain range, about six miles distant from the station, which is not exposed to cold or variable winds. Land and sea breezes prevail in spring and autumn, and the climate is good. The month of November is characterized by dryness, July and August by humidity; December, January, and February being the cold months. From May to September is the hot season during which time strong westerly monsoon winds prevail. Damp cannot be said to exist at any time.
The following are the approximate mean monthly values of temparature :—
The high day temperature varies from 74° in February to 95° in August.
The low night temperature varies from 44° in December to 82° in August.
The mean annual temperature is about 78°; mean daily range 19°.
The annual fall of rain is about 5 inches; the heaviest monthly fall of rain is in July, viz., 1·8 inches.

Sholapore.

Latitude 17° 40′ N., 165 miles S.E. of Poona. Longitude, 76° 0′ E. Height above sea, 1,821 ft.
There is no higher ground within 30 miles of the station, which is completely open, and exposed to the prevailing winds. The sea breeze is not felt at Sholapore; and the only wind that may be said to be unhealthy is that from the east.
The climate is warm and dry during the greater part of the year, the mean annual temperature being about 80°. May is generally the hottest, and December the coldest month. Fogs occasionally occur during the months of February and March towards evening. The atmosphere is pure.
The following are approximate mean monthly values, of temperature :—
The high day temperature varies from 78° in December to 93° in April and May.
The low night temperature varies from 66° in December to 79° in April.
The mean annual temperature is about 74°; mean daily range 9°.
The annual fall of rain is about 33 inches, of which nearly 15 inches fall in July, August, and September.

Seroor.

Latitude, 18° 50′ N., 30 miles S.W. by W. of Ahmednuggur. Longitude, 77° 25′ E. Height above sea, 1,752 ft.
The hill fort of Poorundhur is situated on the nearest table land.
The station generally is remarkably open and exposed to the prevailing winds. The W. wind is most commonly prevalent at the station.
The climate is on the whole, and with the exception of the monsoon months, dry, but not excessively so, being within the influence of the sea breeze which generally blows tolerably strongly towards the evening. The variations of cold and heat, dryness and moisture, are moderate and not sudden. The air is generally free from dust and other impurities, but dust storms do occasionally occur during the hot season.
The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 84° in September to 107° in April.
The low night temperature varies from 50° in January and December to 69° in May and June.
The mean annual temperature is about 75°; mean daily range 33°.
The annual fall of rain is about 21 inches; of which 8 inches fall in the three months ending August.

Malligaum.

Latitude, 20° 32′ N., 154 miles N.E. of Bombay, on the Trunk road from Bombay to Agra. Longitude, 74° 30′ E. Height above sea, 1,300 ft.
Nearest mountain 35 miles distant from the station, which is open and freely exposed to all winds, except those from the sea.

BOMBAY PRESIDENCY.

The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 81° in January to 96° in May.
The low night temperature varies from 64° in January to 82° in June.
The mean annual temperature is about 81° ; mean daily range 14°.

Dhoolia.

Latitude, 20° 54′ N., 181 miles N.E. of Bombay, on the route from Bombay to Agra. Longitude, 74° 45′ E. Height above sea, 1,000 ft.

The nearest high land is the hill fort of Galna, 24 miles distant from the station, which is open, and would be freely exposed to the winds, if not so encumbered with trees, &c. It is exposed to N.W., and occasionally to N. and N.E. winds in December, January, and February, veering to W. in March, and S.W. with monsoon.

The climate is hot and close ; there are but few dust storms.

The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 80° in January to 97° in May.
The low night temperature varies from 62° in January to 83° in June.
The mean annual temperature is about 80° ; mean daily range 13°.

The annual fall of rain is about 84 inches ; about 20 inches fall in the months of July and September.

Mhow.

Latitude, 22° 33′ N. Longitude, 75° 46′ E. Height above sea, 1,862 ft.

The station is open and freely exposed to variable winds, which in the cold season are northerly. The prevailing wind, however, is from the W.

The climate has always been considered good, dry, and cool. The atmosphere is seldom loaded with dust.

The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 74° in December to 95° in May.
The low night temperature varies from 65° in January to 79° in April.
The mean annual temperature is about 74° ; mean daily range 10°.

Neemuch.

Latitude, 24° 27′ N., 155 miles N.W. of Mhow, 371 miles S.W. of Delhi. Longitude, 74° 54′ E., 306 miles W. of Saugor. Height above sea, 1,476 ft.

The nearest mountains are distant 70 miles.

The western side of the camp is well exposed to the prevailing winds, the eastern portion is shut out by the bazaar. For four months of the year N. and N.E. winds prevail, and for the remainder of the year W. and S.W. winds.

The climate varies with the season of the year. From November 15 to February 15 the air is cold, dry, and bracing ; and from the middle of February to the middle of June the heat gradually increases, the maximum being obtained during the month of May, when fierce hot winds prevail. During the monsoon the climate is mild and pleasant. In October the heat again increases, decreasing at the latter end of the month. The diurnal variation of the temperature is great, the nights being generally cool and pleasant, owing to the elevation.

The atmosphere contains but little moisture, even during the monsoon, and the air is free from dust and other impurities.

The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 62° in January to 94° in May.
The low night temperature varies from 49° in January to 78° in June.
The mean annual temperature is about 71° ; mean daily range 14°.

The annual fall of rain is about 34 inches, of which 29¼ inches fall in June, July, and August.

Deesa.

Latitude, 25° 14′ N., 301 miles N.W. of Mhow. Longitude, 72° 5′ E., 251 miles W. of Neemuch. Height above sea, 400 ft., 370 miles N. of Bombay.

The nearest mountain, Aboo, is 16 miles distant from the station, which is open and freely exposed to the winds. The sea-breeze (S.W.) blows from about the middle of March to the end of June, but reaches this station exceedingly dry and scorching. The winds are more variable from July to October, but generally from the S. and W. ; this is the wet season. Between October and March N. winds are most frequent, and four months of this period are dry, cool, and bracing.

BOMBAY PRESIDENCY.

The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 79° in January to 106° in May.
The low night temperature varies from 48° in December to 79° in June and July.
The mean annual temperature is about 80° ; mean daily range 26°.
The annual fall of rain is about 25 inches ; 19 inches fall generally in June, July, and August.

Hyderabad, Sinde.

Latitude, 25° 30′ N. Longitude, 69° 5′ E. Height above sea, 99 ft.
The nearest mountain is about 20 miles distant from the station, which is freely exposed to the winds. Cold and variable winds affect the health of the station more or less.
The climate is exceedingly dry, even when heavy showers of rain fall about July and August. The heat is extreme from the middle of March to the middle of October, and during the day a hot breeze blows from the westward, and dust storms are frequent, but the mornings are clear, cool, and refreshing, except in September and October, when the whole 24 hours are disagreeably oppressive.
The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 71° in January to 99° in May and June.
The low night temperature varies from 58° in January and December to 85° in June.
The mean annual temperature is about 81° ; mean daily range 14°.
The annual fall of rain is about 21 inches ; 15 inches fall in August.

Nusseeraba

Latitude, 26° 20′ N., 222 miles W. of Agra. Longitude, 74° 50′ E., 350 miles N.W. of Saugor. Height above sea, 1,500 ft., 143 miles N. of Neemuch.
There is a range of hills six miles from the station, which is open, and freely exposed to the winds. During the hot season, from the middle of March to the middle of July, the prevailing winds are from the S. and S.W., these are scorching. During the monsoon the winds are variable and pleasant. In the cold season, from November to March, the winds are from the N. and N.E.
With regard to the climate, the temperature ranges very high for about five or six months, in July sometimes rising to 120°, and during the hot season there is a hot wind blowing constantly, day and night from the W. During the hot season, the station is visited with severe dust storms, causing great discomfort.
The following are the approximate mean monthly values of temperature :—
The high day temperature varies from 65° in January to 99° in June.
The low night temperature varies from 59° in December to 88° in June.
The mean annual temperature is about 79° ; mean daily range 9°.
The annual fall of rain is about 16 inches ; 8 inches fall in August, 13 inches in the three months ending August.

Abstract of Remarks and Collected Facts on the Geology, Topography, Population, Mountains, Rivers, &c., of India.—By R. M. Martin, Esq.

Geology.

It will require many more years of scientific research before an accurate geological map can be laid down for India.* Immense tracts covered with impenetrable forests, the few Europeans in the country occupied with military and civil governmental duties, the lassitude of mind and body which, sooner or later, oppresses the most energetic, and the malaria which inevitably destroys those who attempt to investigate the crust of the earth, overrun with jungle, or immersed in swamp,—these and other obstacles render the prosecution of this science a matter of extreme difficulty. All that can here be attempted is to collate the best known data, and arrange them in outline, for reference and future systematic exposition.†

Representatives of all the series found in Europe and other parts of the world are traceable in India. Mr. Carter has industriously noted the observations of various investigators; and the following summary is partly abstracted from his compilation :—

Older Metamorphic Strata.—*Gneiss, Mica Schiste, Chlorite Schiste, Hornblende Schiste, Quartz Rock, Micaceous Slate, Talcose Slate, Clay Slate, Granular Limestone.*

Gneiss.—Most general and abundant,—occurring in different parts of the Himalaya; Oodeypoor; near Baroda; Zillah Bahar; Rajmahal hills; Phoonda Ghaut; Northern Circars; and more or less throughout the "peninsula" (? Deccan) to the Palghaut, and probably to Cape Comorin: it is frequently veined by granite, contains in most places specular iron ore: beds of garnets common everywhere: corundum in southern India, and beryl in Mysoor. Composition varied in texture, compactness, and with more or less mica; colour—speckled, black, brown, reddish gray to white; sometimes tinted green where chlorite replaces mica: when very fine-grained and decomposing, gneiss bears a close resemblance to fine-grained sandstone.

Mica Schiste.—Southern Mahratta country, and western extremities of Vindhya range, passes into micaceous slate at the Phoonda Ghaut: veined with quartz, but no granite: being associated with gneiss and hornblende schistes, they pass into each other.

Chlorite Schiste.—Southern Mahratta country: it also contains garnets.

Hornblende Schiste, forms the sides of the Neilgherries, where it is from five to seven miles in breadth: garnets found in it. Southern Mahratta country, Salem; and often passes into mica schiste on the Malabar coast.

Quartz Rock.—Hills between Delhi and Alwur, and between Ajmere and Oodeypoor; mountains around Deybur Lake, Chittoor, and at the western part of the Vindhya range, with mica slate; southern Mahratta country; more or less in the granitic plains of Hydrabad, and in the *droogs* of Mysoor. The rock is compact and granular in the Ajmere mountains; and of a red, violet, gray, or brown colour; brilliantly white in the Mahratta country. Mica is frequently disseminated throughout the rock in large masses; talc and chlorite, occasionally.

Micaceous Slate and Chlorite Slate.—Both at the Phoonda Ghaut; and the latter in the Mahratta country. The micaceous occurs in the Indo-Gangetic chain, Koonawur; and in the Soolumbur range, Oodeypoor.

Clay Slate, appears to be of great thickness, and considerable extent, viz., from the Arravulli range, the lower part of which is composed of this formation; thence to Oodeypoor, *viâ* the Soolumber range, across the Durgawud valley to Malwa, on the Kistnah; southern Mahratta country, Nellore; and in the Eastern Ghauts at Junga-

* The late eminent geologist, J. B. Greenough, has made an excellent beginning by his large map on this subject, and by the voluminous materials he collected.

† *See* a valuable *Summary of the Geology of India, between the Ganges, the Indus, and Cape Comorin*; by H. J. Carter, Asst. Surg. Bombay Establishment, Aug. 1853; reprinted from Journal of Bombay British Asiatic Society, p. 156.

manipenta, a ferruginous clay-slate overlies the trap at Mahabulishwar. In the Arravulli it is massive, compact, and of a dark blue colour. The Soolumber range is almost entirely composed of this and chlorite slate. Micaceous passes nto clay-slate at the Phoonda, and, farther south, the Saltoor passes (Western Ghauts). This also occurs at the Carrackpoor hills (Bahar), where the clay-slate is about 20 miles wide, and extends in the direction of the strata.*

Plutonic Rocks.—*Granite, Diorite or Greenstone.*

Granite.—Himalaya; Ajmere and around Jeypoor, traversing the mountains in veins and dykes; the Arravulli range consists chiefly of granite, resting on slate; Mount Aboo; from Balmeer across the sands to Nuggur Parkur; the Gir; Girnar; between Oodeypoor and Malwa, are all varieties: it extends more or less southward to the Nerbudda; on that river between Mundela and Amarkantak, Jubbulpoor, Kalleenjur, Zillah Bahar, Carrackpoor hills; in Bhagulpore and Monghyr districts; near Baitool; Nagpore territory; Cuttack; Orissa; Northern Circars; Hydrabad; between the Kistnah and Godavery; Gooty; Neilgherries; Malabar coast at Vingorla; Coromandel; between Madras and Pondicherry; ending at Cape Comorin. The granitic rocks vary in structure and composition, as they do in colour, thus they are *syenitic*, *pegmatitic*, and *protogenic*. It is gray at Ramteak in Nagpoor, red generally in the Deccan, but at Vencatigherry (Mysoor), and at Vingorla, gray; in the Neilgherries it is syenitic.

Greenstone.—Hazareebagh, Mahratta country, Mysoor, Nellore, Chingleput, Madras, Trichinopoly, Salem, in the granitic plains of Hydrabad; and extensively throughout Southern India. In the Deccan the dykes may be traced continuously for 20 miles; about Hydrabad they are from 100 to 300 feet broad; about four miles from Dhonee, between Gooty and Kurnool, there is one 150 feet high, and 200 feet broad, passing through a range of sandstone and limestone mountains.

Silurian Rocks.—*Greywacke.*—Ghiddore, Rajmahal hills; Kumaon. It is a quartzose sandstone; yellow colour, resinous lustre, and compact splintery fracture.

Transition or Cambrian Gneiss, is of great extent in Bhagulpore district, composing two-thirds of the country between the Curruckpore and Rajmahal hills, and the greater portion of the southern ridges of the latter group. It consists of quartz, more or less, hornblende, felspar, mica, and garnet pebbles.

Oolitic.—*Limestone.*—Cutch; near Neemuch, Malwa; Bundelcund; on the river Sone; Firozabad, on the Bheema; Kulagee, in the southern Mahratta country; on the Kistnah; and as far south as Cuddapah. Though its principal characters are its uniform lithographic texture, solidity, conchoidal smooth fracture, and hardness,—dendritic surface, smoky gray colour, passing into dark smoky blue; and parallel thin stratification,—it differs when departing from its general composition, just as the shales differ which interlaminate it, the coal strata, and the sandstone, as being more or less argillaceous, bituminous, or quartziferous; of different degrees of hardness, coarseness, and friability of structure; and of all kinds of colours, streaked and variegated. It is occasionally veined, and interlined with jasper and light-coloured cherts, which, near Cuddapah, give it a rough appearance; also contains drusy cavities, calcedonies, and cornelian, north of Nagpoor; in the bed of the Nerbudda between Lamaita and Beragurh, near Jubbulpoor, of a snow-white colour, and traversed by chlorite schiste. It is frequently denuded of its overlying sandstone and shales in Southern India, and in this state is not uncommonly covered by trap, as near Ferozabad on the Bheema.

Thickness, 310 feet near Kurnool; 10 to 30 feet on the Bheema, with strata from 2 inches to 2 feet thick. In the part of the Himalaya examined by Captain Strachey, the secondary limestones and shales were several thousand feet in thickness, the upper portion being in some places almost made up of fragments of shells.

If the white crystalline marble generally of India is allowed to be metamorphic strata, this limestone exists in the Girnar rock of Kattywar; the lithographic form in Cutch, and between Neemuch and Chittore; the white marble about Oodeypoor, and

* In the neighbourhood of Calcutta a series of boring experiments to find water were carried on at intervals between 1804 and 1833; the results were, artificial soil at surface; next as follows:—A light blue or gray-coloured sandy clay, becoming gradually darker from decayed vegetable matter, until it passes at 30 ft. deep into a 2 ft. stratum of black peat, apparently formed by the *débris* of Sunderbund vegetation, which was once the delta of the Ganges; below the peat a black clay and in this and the gray clay immediately above the peat, logs and branches of yellow and red wood, found in a more or less decayed state. In one instance only bones were discovered, at 28 feet deep. Under blue clays, at 50 to 70 feet deep, *kunkur* and *bagiri* (apparently small land shells, as seen in Upper India). At 70 feet a seam of loose reddish sand,—75 to 125 feet beds of yellow clay predominate, frequently stiff and pure like potter's clay, but generally mixed with sand and mica; horizontal strata of kunkur pass through it, resembling exactly those found at Midnapoor. Below 128 feet a more sandy yellow clay prevails, which gradually changes to a gray, loose sand, becoming coarser in quality to the lowest depth yet reached (176 feet), where it contains angular fragments as large as peas, of quartz and felspar.

northwards in the neighbourhood of Nusseerabad, Jeypoor, Bessona, and Alwar; a narrow strip about 150 miles long in Bundelcund; again about Bidjyghur and Rhotasghur on the Sone; white marble in the bed of the Nerbudda, near Jubbulpoor; in the hills north-east of Nagpoor; near the junction of the Godavery and Prenheta rivers; thence along the Godavery more or less to Rajahmundry; Sholapoor district; on the Bheema; of every variety of colour, and greatly disturbed and broken up about Kaludgee, in the southern Mahratta country; along the Kistnah, from Kurnool to Amarawattee; and more or less over the triangular area formed by the latter place, Gooty, and the Tripetty hills. Chunam, an argillaceous limestone, used for building in Bengal, Bahar, Benares, &c.,* occurs in nodules in the alluvium, which, at Calcutta, is 500 to 600 feet thick. Near Benares, it contains fragments of fresh-water shells. South of Madras, a dark clay abounds in marine shells, used in preference for lime-burning to those on the beach, as being freer from salt.

Sandstone,—appears to be composed of very fine grains of quartz and more or less mica, united together by an argillaceous material. It exists in Cutch; in the Panna range, Bundelcund; the Kymore hills; ceded districts; in lat. 18°, 15 miles west of the Godavery; on the banks of the Kistnah; plains of the Carnatic, and the districts watered by the Pennar river. It is present in the sub-Himalaya range, and in the Rajmahal hills. All the towns on the Jumna, from Delhi to Allahabad, appear to be built of this sandstone. The plains of Beekaneer, Joudpoor, and Jessulmere, are covered with the loose sand of this formation. It borders on the northern and western sides of the great trappean tract of Malwa, and forms the north-eastern boundary of the Western India volcanic district.

Its thickness varies, either from original inequality or subsequent denudation. Its greatest depth, at present known, is in the eastern part of the Kymore range, where it is 700 feet at Bidjighur; and 1,300 feet at Rhotasghur; at the scarps of the waterfalls over the Panna range, it does not exceed 360 or 400 feet; from 300 to 400 feet is its thickness near Ryelcherroo and Sundrogam, in the ceded districts. Its greatest height above the sea is on the banks of the Kistnah, 3,000 feet. Organic remains are very abundunt in this formation. It has been ascertained that the great trap deposit of the Western Ghauts, rests on a sandstone containing vegetable remains, chiefly ferns.

Volcanic Rocks.†—*Trap*.—The largest tract is on the western side of India, and extends continuously from the basin of the Malpurba to Neemuch in Malwa; and from Balsar, about 20 miles south of the mouth of the Taptee, to Nagpoor. This is probably the most remarkable trap-formation existing on the surface of the globe; its breadth is about 335 miles N. to S.; length about 350 miles E. to W.; and covers an area of from 200,000 to 250,000 square miles.‡ Another portion extends from Jubbulpoor to Amarakantak, thence south-westerly towards Nagpoor. It constitutes the core of the Western Ghauts, and predominates in the Mahadeo and Sautpoora mountains.

Its two grand geological features along the Ghauts, where it has attained the highest elevation, are flat summits and regular stratification. Fourteen beds have been numbered in Malwa, the lowest and largest of which is 300 feet thick. These are equally numerous if not more so, along the Ghauts, but the scarps are of much greater magnitude. Besides its stratification, it is in many places columnar; as in the beds of the Nerbudda and Chambul; and the hill fort of Singhur presents a surface of pentagonal divisions.

Wherever the effusions exist to any great extent, they appear to be composed of *laterite* above, then *basalt*, and afterwards *trappite* and *amygdaloid*.

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* The British Residency at Hydradad (Deccan) is a specimen; the Corinthian columns, &c., being executed in white chunan.

† Volcanic fires are said, by the natives, to exist among the loftier peaks of the Hindoo-Koosh and the Himalayan ranges, but earthquakes are of rare occurrence. A severe convulsion was experienced throughout a large extent of country on 26th August 1833,—vibration from N.E. to S.W., with three principal shocks; first at 6.30 p.m.; second, 11.30 p.m.; and third, at five minutes to midnight. It was most severely felt at and near Katmandoo, where about 320 persons perished; the trembling of the earth commenced gradually, and then travelled with great rapidity towards the westward; and increased in violence until the houses seemed shaken from their foundation,—large-sized trees bent in all directions; the earth heaved fearfully; and while the air was perfectly calm, an awful noise burst forth as if from a hundred cannon. Probably in India, as in Australia, subterranean igneous action, which was formerly very violent, is now almost quiescent, or finds its vent through mighty chimneys at a height of four or five miles above the sea. The Lunar Lake, 40 m. from Saulna, is a vast crater 500 feet deep, and nearly five miles round the margin; its waters are green and bitter, super-saturated with alkaline carbonate, and containing silex and some iron in solution; the mud is black, and abounds with sulphuretted hydrogen; the water is, nevertheless, pure and void of smell.

‡ The rock in which the Ellora caves are excavated is said to be a basaltic trap, which, from its green tinge and its different stages from hardness to disintegration, is supposed, by the natives, to be full of vegetable matter, in a greater or less advance to putrefaction; the crumbling rock affords a natural green colour, which is ground up and employed in painting on wet chunam (lime plaster).

Basalt.—There are two kinds of this rock ; a dark blue-black, and a brown black. Both are semi-crystalline. Their structure is massive, stratified, columnar, or prismoidal. Dark blue is the basalt of Bombay island, brown-black that of the Deccan.

To this general description I may add what I have been enabled to glean of the specific structure of some of the principal positions :—

Himalayas.—Formations primary ; the first strata, which is towards the plain, consists of limestone, lying on clay-slate, and crowned by slate, graywacke, or sandstone. Beyond the limestone tract, gneiss, clay-slate, and other schistose rocks occur ; granite arises in the mountains near the snowy ranges. The peaks are generally composed of schistose rocks, but veined by granite to a great elevation. Kamot, however, is an exception, appearing to consist of granite alone. Greenstone dykes rise through and intersect the regular rocks. Strata fractured in all directions ; slate as if crushed, and the limestone broken into masses. The soil is principally accumulated on the northern side.

The formation of the Indo-Gangetic chain, in Koonawur, is mostly gneiss and mica-slate ; in some places, pure mica. On the left bank of the Sutlej, granite prevails, forming the Raldang peaks. Further north, it becomes largely intermixed with mica-slate ; to the north-east changes into secondary limestone, and schistose rocks, abounding in marine exuviæ.* In Kumaon, the Himalayas are composed of crystalline gneiss, veined by granite ; the range forming the north-eastern boundary is believed to be of recent formation. The mountainous tract south of the principal chain in Nepaul consists of limestone, hornstone, and conglomerate. The Sewalik (the most southerly and lowest range of the Hamalayan system) is of alluvial formation, consisting of beds of clay, sandstone with mica, conglomerate cemented by calcareous matter, gravel, and rolled stones of various rocks. The supposition is, that it is the *débris* of the Himalaya, subsequently upheaved by an earthquake. The geology of the Sewalik is characterised by the occurrence of quantities of fossil remains.

Punjab.—Near the north-east frontier, in the vicinity of the Himalaya, is an extensive tract of rocks and deposits of recent formation ; limestone, sandstone, gypsum, argillaceous slate ; occasionally veins of quartz.

The Salt-range.—Greywacke, limestone, sandstone, and red tenaceous clay, with deposits of chloride of sodium, or common salt.

The Sufied-Koh is *primary*, consisting of granite, quartz, mica, gneiss, slate, and primary limestone.

The Suliman mountains are of *recent* formations, principally sandstone and secondary limestone, abounding in marine exuviæ.

Central India.—Arravulli range, generally primitive, consisting of granite, quartz, and gneiss. Formation along banks of upper course of Nerbudda, trappean ; lower down, at Jubbulpoor, granitic ; at Bhera Ghur, channel contracted between *white* cliffs of magnesian limestone ; at the junction of the Towah, there is a ledge of *black* limestone ; at and near Kal Bhyru, slate of various sorts ; basaltic rocks scattered over channel. Ranges enclosing Nemaur banks of rivers, and eminences in the valley, basaltic. Saugor and Nerbudda territory ; eastern part, towards Amarakantak, generally sandstone ; from here it extends westward, forming the table-land bounding Nerbudda valley on the north, and is intermixed with marl, slate, and limestone. The volcanic tract commences about longitude 97°, and extends to about the town of Saugor, which is situate on its highest part. This (trap), with that of sandstone further east, may be considered to belong to the Vindhya ; and the former to the Mahadeo and Sautpoora ranges. In some places primitive rocks appear through the overlying bed. The Bindyachal hills are of horizontally-stratified sandstone ; Panna hills, sandstone, intermixed with schiste and quartz ; and, to the west, overlaid by limestone.

Western Ghauts.—The great core is of primary formation, enclosed by alternating strata of more recent origin. These have been broken up by prodigious outbursts of

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* Dr. Gerard found some extensive tracts of shell formation 15,000 ft. above the sea. The principal shells comprised cockles, mussels, and pearl-fish ; nummulites and long cylindrical productions. These shells, of which many were converted into carb. of lime, some crystallized like marble, were lying upon the high land in a bed of granite in a pulverized state : the adjacent rocks composed of shell limestone, the large blocks formed of a multitude of shells of different sizes, imbedded in a mass of calcareous tufa. Four classes of shell formation were distinguished ; one in particular, a freshwater bivalve, resembling the *unio*, which exists in great abundance at the foot of the lower hills and throughout the Dooab. In the Neermal hills, north of the Godavery, on the road from Hydrabad to Nagpoor, many very perfect fossil shells, mostly bivalves, and evidently marine, have been discovered imbedded in a volcanic rock, together with the head and vertebra of a fish ; the formations around rest everywhere on granite ; and there are several hot springs holding lime in solution. Univalves and bivalves, particularly buccinum, ammonites, and mussels, abound in Malwa.

volcanic rocks ; and from Mahabulishwar northward, the overlying rock is exclusively of the trap formation ; behind Malabar they are of primitive trap, in many places overlaid by immense masses of laterite, or iron-clay. The Vurragherry or Pulnai hills (Madura) are gneiss, stratified with quartz ; in some places precipices of granite.

Nagpoor.—North-western and western part, volcanic, principally basalt and trap. This terminates at the city of Nagpoor, and the primitive, mostly granite and gneiss, rises to the surface.

Mysoor.—The *droogs*, huge isolated rocks, scattered over the surface ; vary in elevation from 1,000 to 1,500 feet; basis seldom exceeding 2 miles in circumference ; generally composed of granite, gneiss, quartz, and hornblende ; in many places overlaid by laterite.

Soils.

Mainly determined by the geological character of each district, except in the deltas, or on the banks of rivers, as in the Punjab, where an alluvium is accumulated. The land in Lower Bengal is of inexhaustible fertility, owing partly to the various salts and earthy limestone with which the deposits from the numerous rivers are continually impregnated : it is generally of a light sandy appearance. The alluvium of Scinde is a stiff clay ; also that of Tanjore, Sumbulpore, and Cuttack, by the disintegration of granitic rocks. A nitrous (saltpetre) soil is general in Bahar ; in the vicinity of Mirzapoor town, it is strongly impregnated with saline particles ; and at many places in Vizagapatam. The *regur*, or cotton ground, which extends over a large part of Central India, and of the Deccan, is supposed to be formed by a disintegration of trap rocks ; it slowly absorbs,* and long retains moisture ; and it has produced, in yearly succession, for centuries, the most exhausting crops. It spreads over the table-lands of the Ceded Districts and Mysoor, flanks the Neilgherry and Salim hills, and pervades the Deccan, but has not been observed in the Concans. It is a fine, black, argillaceous mould, containing, in its lower parts, nodules, and pebbly alluvium. *Kunkur* (a calcareous conglomerate)† fills up the cavities and fissures of the beds beneath it; and angular fragments of the neighbouring rocks are scattered over its surface. It contains no fossils. In some parts it is from 20 to 40 feet thick. *Kunkur* is common in the north-western provinces, the rocks often advancing into the channel of the Jumna, and obstructing the navigation. In the western part of Muttra district, it is mixed with sand : in Oude, some patches of this rock, which undergo abrasion very slowly, stand 70 or 80 feet above the neighbouring country, which, consisting of softer materials, has been washed away by the agency of water. Its depth, in the eastern part of Meerut district, is from one to 20 feet. In the Dooab, between the Ganges and Jumna, and in many parts of the N.W. provinces, there is a light rich loam, which produces excellent wheat; at Ghazeepore, a light clay, with more or less sand, is favourable for sugar and for roses. As the Ganges is ascended before reaching Ghazeepore, the soil becomes more granitic, and is then succeeded by a gravel of burnt clay, argite and cinders, resembling what is seen in basaltic countries. Assam, which has been found so well adapted for the culture of tea, has for most part a black loam reposing on a gray, sandy clay; in some places the surface is of a light yellow clayey texture. The soil usually found in the vicinity of basaltic mountains is of a black colour, mixed with sand. Disintegrated granite, where felspar predominates, yields much clay.

A sandy soil exists in the centres of the *Dooabs*, of the Punjab; more or less in Paniput, Rhotuck, and Hurriana districts: Jeypoor, Machery, and Rajpootana; and in some parts of Scinde ; in Mysoor, a brown and rather sandy earth prevails ; Trichinopoly is arid and sandy; and near Tavoy town, on the east side of the Bay of Bengal, there is a large plain covered with sand.

The soil of Nagpoor, in some tracts, is a black, heavy loam, loaded with vegetable matter ; red loam is found in Salem and in Mergui.

Tinnevelly has been found well suited for the cotton plant, and the substance in which it delights looks like a mixture of lime, rubbish, and yellowish brickdust, intermixed with nodules of *Kunkur*.‡ A chemical analysis of three of the best cotton soils in these districts gives the following results § :—

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* Most of the soils of India have a powerful absorbing quality; hence their fertile properties.

† *Kunkur*.—A calcareous concretion, stratified and in mammilated masses of all sizes, which contains 50 to 80 per cent. of carbonate of lime, some magnesia, iron, and alumina: these nodules are interspersed in large quantities throughout extensive tracts of the alluvial and secondary formations, and are ascribed to the action of calcareous springs which are of frequent occurrence.

‡ It is curious to note, in different countries, how plants seem to vary in their feeding: thus, at Singapore, the best cotton soil *apparently* consists of large coarse grains of white sand, mixed with something like rough charcoal dust, and with fragments of vegetables and mosses of all sorts. A somewhat similar substance, mingled with shells and decayed vegetable matter, is the favourite *habitat* of the Sea Island cotton of Georgia, U.S.

§ *See* an interesting *Essay on the Agriculture of Hindoostan*, by G. W. Johnston.

Cotton Soils.	Vegetable matter.	Saline and Extractive.	Iron.			Carb. lime.	Magnesia.	Alumina.	Silex.	Water and loss.	Remarks.
			Protox.	Deutox.	Tritox.						
Bundelcund	2·00	0·33	—	7·75	—	11·90	trace	3·10	74·0	1·00	No peat or lignite; nothing soluble in cold water; silex in fine powder; kunkur in the gravel.
Coimbatore -	2·30	traces	4·00	—	—	7·50	trace	2·80	82·80	0·60	Gravel, mostly silex, with some felspar, but no kunkur.
Tinnevelly -	0·15	0·20	—	—	2·88	19·50	0·15	2·00	74·00	1·12	Gravel, almost wholly kunkur; some carb. iron; half the soil of gravel.

Guzerat is generally termed the Garden of Western India. With the exception of Kettywar, and to the eastward of Broach, it is one extensive plain, comprising many different soils; the chief varieties being the black or cotton soil, and the *gorat*, or light grain-producing soil.* The former is chiefly confined to Broach, and part of Surat N. of the Taptee; the latter prevails throughout Baroda, Kaira, and part of Ahmedabad, becoming more mixed with sand to the northward; black soil abounds to the westward of the gulf, and in many of the Kattywar valleys. The numerous vegetable products of India attest the variety of soils which exist there.

Minerals.

Various metals have been produced and wrought in India from the earliest ages: the geological character of the different districts indicates their presence. So far as we have yet ascertained, their distribution is as follows:—

Iron.—Ladakh.—Mines in the north-eastern part of the Punjab,† and in almost every part of Kumaon, where the requisite smelting processes are performed, though on a small scale, and in a rude and inefficient manner. Mairwarra; in veins, and of good quality, believed to be inexhaustible. Rajmahal; in gneiss. Lalgang, 16 miles south-west of Mirzapoor city. Kuppudgode hills; in schistes, quartz, and gneiss: on the north-east side, one stratum of iron, 60 feet thick. Ramghur; hills abounding in iron, though not of the best quality. Hazareebagh, in gneiss—flinty brown colour, pitchy lustre, and splintery fracture; 20 feet thick. Various parts of Palamow district; at Singra in inexhaustible quantities. Eastern part of Nagpoor territory. Mine of good quality at Tendukhera, near Jubbulpoor (were the navigation of the Nerbudda available, this would prove a most useful article of export for railways). Western extremity of Vindhya; in gneiss. Southern Mahratta country, in quartz: micaceous and magnetic iron-ore occur in the same district; in clay-slate. In all the mountains in the Western Ghauts; in Malabar; in veins, beds, or masses, in the laterite (here extensively smelted). Salem, southern part (yields 60 per cent. of the metal fit for castings). Nellore district. In many places in Masulipatam. Rajahmundry; in sandstone hills. Vizagapatam. Abundant in many parts of Orissa. Tenasserim provinces; occurs in beds, veins, and in rocks. Between the Salem and Gyne rivers, it is found in sandstone hills. Most abundant between Ye and Tavoy, approximating the sea-coast; the best is at a short distance north of Tavoy town: it is there in two forms—common magnetic iron-ore; and massive, in granular concretions, crystallized, splendent, metallic, highly magnetic, and with polarity. The ore would furnish from 74 to 80 per cent. raw iron. In various places the process of smelting is rudely performed by the natives, but they produce a metal which will bear comparison with the best Swedish or British iron.‡

Tin.—Oodeypoor,—mines productive. On the banks of the Barakur, near Palamow; in gneiss. Tenasserim provinces. Tavoy, rich in tin-ore; generally found at the foot of the mountains, or in hills; Pakshan river, soil in which the grains are buried, yields 8 or 10 feet of metal; at Tavoy, 7 feet: of superior quality in the vicinity of Mergui town.

* *See* Mackay's valuable *Report on Western India*, p. 41.

† Colonel Steinbach says that the mineral wealth of the Punjab is considerable; that mines of gold, copper, iron, plumbago, and lead abound, and that "properly worked they would yield an enormous "revenue."

‡ The natives of Cutch make steel chain-armour, sabres, and various sharp edge tools from their iron; the horse-shoes are excellent—the metal being more malleable, and not so likely to break as English iron.

Lead.—Ladakh. Koonawur. Ajmere; in quartz rocks. Mairwarra. Eastern part of Nagpoor. In the vicinity of Hazareebagh. Eastern Ghauts at Jungamanipenta; in clay-slate—mines here. Amherst province. Fine granular galena obtained in clay-slate, and clay limestone on the Touser, near the Dehra-Doon.

Copper.—Ladakh. Koonawur, in the valley of Pabur. Kumaon, near Pokree; but these mines are almost inaccessible, and the vicinity affords no adequate supply of fuel for smelting: others at Dohnpur,* Dhobri, Gangoli, Sira, Khori, and Shor Gurang. Mairwarra. Oodeypoor; abundant,—it supplies the currency. Southern Mahratta country, in quartz; also in a talcose form. Vencatigherry, North Arcot. Nellore district.† Sullivan's and Callagkiank Islands, in the Mergui Archipelago. This metal is most probably extensively distributed and of a rich quality.

Silver.—In the mines of Oodeypoor. In the lead mine, near Hazareebagh, and other places.

Gold.—Sands of Shy-yok, Tibet. Ditto Chenab, Huroo, and Swan Rivers, Punjab. Ditto Aluknunda, Kumaon. Throughout the tract of country W. of the Neilgherries, amid the rivers and watercourses, draining 2,000 sq. m., this coveted metal abounds; even the river stones, when pounded, yield a rich product; it is usually obtained in small nuggets. In the iron sand of the streams running from the Kuppudgode hills, and from the adjoining Saltoor range. Sumbulpoor; in the detritus of rocks. In moderate quantities in several places in the eastern part of Nagpoor. Many of the streams descending from the Ghauts into Malabar; and in Wynaad. Gold-dust in Mysoor.‡ In the Assam rivers it is plentiful: near Gowhatty, 1,000 men used to be employed in collecting ore for the state. Various parts of Tenasserim provinces, but in small quantities. The geological structure of India indicates an abundance of the precious metals.

Coal.—The carboniferous deposits of the *oolitic series* in Bengal west of the Ganges and Hooghly, consist of coal, shale, and sandstone, but no limestone, and they appear chiefly to occupy the depressions of the granitic and metamorphic rocks which form this part of India, becoming exposed in the banks or beds of watercourses or rivers which have passed through them, or in escarpments which have been produced by upheaval of the rocks on which they were deposited. The coal occurs in strata from an inch or less to 9 or 10 feet thickness, interstratified with shale and sandstone; the whole possessing a dark black or blue colour, of a greater or less intensity. At Burdwan its character is slaty: the genera of plants are partly English, some Australian, some peculiar. The depth at the Curhurbalee field, situated sixty miles south of the Ganges, near Surajgurrah, is from 50 to 100 feet. Proceeding westerly, towards Palamow district, which contains many valuable and extensive fields, and where several shafts have been sunk, it has been seen about 16 m. from Chergerh, in Singrowla; at the confluence of the Sone and Tipan, about 30 m. E. from Sohajpoor. Near Jeria, in Pachete district. Hills in Ramghur, abounding in coal. Jubbulpoor, 30 m. S. from Hoosungabad; in Shahpoor in the same neighbourhood; and abundantly along the valley of the Nerbudda. Traces of it are said to exist in the diamond sandstone north-west of Nagpoor, and it has been found in the Mahadeo mountains. In the Punjab, at Mukkud, on the left bank of the Indus, and in the localities of Joa, Meealee, and Nummul. The extremes of this coal formation, so far as have yet been discovered in India, are,—the confluence of the Godavery and Prenheta in the south, in lat. 19°, and the salt range in about 33° N.; Cutch in the west, and Burwan in the east; and detached in Silhet, Pegu (recently found of excellent quality), and the Tenasserim provinces (plentiful, and possessing good properties). There are many other places, no doubt, in the country between Bengal and Berar, where this valuable mineral exists; traces of it have been observed in Orissa, but it has not yet been found available for use; it is not improbable that it extends across the delta of the Ganges to Silhet, distant 300 miles. It also occurs extensively in the grits bounding the southern slope of the Himalaya: it has been questioned whether this is the older coal, or only lignite associated with nagelflue,—where the Teesta issues from the plain, its strata is highly inclined, and it bears all the other characters

* The gray ore found in Dohnpur affords 30 to 50 per cent. of copper; it is associated with malachite, and contained in a compact red-coloured dolomite. Hence mining operations can be carried on without timbering or masonry.

† Mines discovered by Dr. Heyne, near Wangapadu. "A footpath, paved with stones, led up the "hill to the place which was shown me as one of the mines. It is situated two-thirds up the hill, and "might be about 400 feet above the village (Wangapadu). An open gallery cut into the rock demon-"strated that it had been formerly worked; and as the stones, which lay in abundance near it, were "all tinged or overlayed with mountain green, there could be no doubt that the ore extracted had "been copper."—(Heyne, *Tracts on India*, p. 112.)

‡ In excavating the disintegrating granite in the vicinity of Bangalore, to ascertain the extent to which the decomposing influence of the atmosphere will affect the solid rock (viz., 30 to 35 ft.), the contents of soil were frequently auriferous. In blasting syenite at Chinapatam, 40 miles from Bangalore, on the road to Seringapatam, Lieutenant Baird Smith, B.E., observed considerable quantities of gold disseminated in small particles over the fractured surfaces. At Wynaad this metal was obtained from rich yellow earth in sufficient quantity to employ a number of labourers and to yield some return.

of the older formation. Analysis of Indian coal found in different parts, and near the surface, gave the following results:—Chirrapoonjee, slaty kind: specific gravity, 1·497; containing volatile matter, 36; carbon, 41; and a copious white ash, 23=100. Nerbudda (near Fatehpoor), near the surface,—volatile matter, 10·5; water, 3·5; charcoal, 20; earthy residue (red), 64=110. Cossyah hills: specific gravity, 1·275; volatile matter or gas, 38·5; carbon or coke, 60·7; earthy impurities, 0·8=100 —(ash very small). Hurdwur: specific gravity, 1·968; volatile matter, 35·4; carbon, 50; ferruginous ash, 14·6=100. Arracan: specific gravity, 1·308; volatile matter, 66·4; carbon, 33; ash, 0·6=100. Cutch: charcoal, 70; bitumen, 20; sulphur, 5; iron, 3; calcareous earths, 2.

Sulphur.—Mouths of Godavery, and at Condapilly, on the Kistnah. Sulphate of alumina obtained from the aluminous rocks of Nepaul; used by the natives to cure fresh wounds or bruises: yields on analysis—sulphate of alumina, 95; peroxyde of iron, 3; silex, 1; loss, 1. Sulphate of iron is procured in the Behar hills, and used by the Patna dyers; it yields sulphate of iron, 39; peroxyde of iron, 36; magnesia, 23: loss, 2=100.

Diamonds.—Sumbulpoor has been celebrated for the finest diamonds in the world; they are found in the bed of the Mahanuddy. Mines were formerly worked at Wyraghur, Nagpoor; Malaville, in Masulipatam (near Ellore); and at Panna, in Bundelcund. Mr. H. W. Voysey described, in 1824, the diamond mines of the *Nulla Mulla* mountains, north of the Kistnah,* which were formerly extensively worked.†

Rubies.—Sumbulpoor; in the detritus of rocks.

Pearls.—Gulf of Manaar, near Cape Comorin, and on the coast of many of the islands in the Mergui Archipelago.

Muriate of soda (common salt) is found in rock and liquid form at various places. A salt lake, 20 miles long by 1½ broad, is situated in lat. 26° 53′, long. 75° 57′; it supplies a great portion of the neighbouring country with salt after the drains are dried up. A salt lake in Berar contains in 100 parts,—muriate of soda, 20; muriate of lime, 10; muriate of magnesia, 6. Towards the sources of the Indus, salt lakes exist at 16,000 feet above the sea. There are extensive salt mines in the *Salt range* of the Punjab. Natron and soda lakes are said to exist in the Himalaya.

Cornelian is found and worked in different places: the principal mines are situated at the foot of the western extremity of the Rajpeepla hills, close to the town of Ruttunpoor; the soil in which the cornelians are imbedded consists chiefly of quartz sand—reddened by iron, and a little clay. Agates abound in Western India: at one part of Cutch the sides of the hills (of amygdaloid) are covered with heaps of rock crystal, as if cart-loads had been purposely thrown there, and in many parts of the great trappean district the surface is strewed with a profusion of agatoid flints, onyx, hollow spheroids of quartz, crystals, and zoolitic minerals. There are evidences of several extinct volcanoes in Cutch.

This is but an imperfect sketch of the minerals of India: doubtless, there many more places where metals exist; but during the anarchy and warfare which prevailed prior to British supremacy, the very knowledge of their locality has been lost. At no distant day this subterranean wealth will be developed; and probably, when the gold fields of Australia are exhausted, those of India may be profitably worked.

Population.

From remote antiquity India has been densely peopled; but we know nothing certain of its indigenous inhabitants,—of accessions derived from immigration, or from successful invasions by sea and land,—of the progressive natural increase,—or of the circumstances which influence, through many generations, the ebb and flow of the tide of population.‡ There is direct

* These mountains are bounded on all sides by granite, that everywhere appears to pass under it, and to form its basis: some detached portions have only the upper third of their summits of sandstone and quartz, the basis or remaining two-thirds being of granite. Deep ravines are not infrequent. The diamond is procured only in the sandstone breccia, which is found under a compact rock, composed of a beautiful mixture of red and yellow jasper, quartz, chalcedony, and hornstone, of various colours, cemented together by a quartz paste; it passes into a pudding-stone of rounded pebbles of quartz, hornstone, &c., cemented by an argillo-calcareous earth of a loose friable texture, in which the diamonds are most frequently found. The breccia is seen at depths varying from 5 to 50 feet, and is about 2 feet in thickness; immediately *above* it lies a stratum of pudding-stone, composed of quartz and hornstone pebbles, cemented by calcareous clay and grains of sand. The miners are of opinion that the diamond is always growing, and that the chips and small pieces rejected, ultimately increase to large diamonds.—*Trans. A.S. Bengal*, vol. xiv., p. 120.

† The diamonds of Golconda have obtained great celebrity throughout the world, but they were merely cut and polished there, having been generally found at Parteall, in a detached portion of the Nizam's dominions, near the southern frontier, in lat. 16° 40′, long. 80° 28′.

‡ It is not improbable that some of the early immigrants were offshoots of the colonists who are said to have passed from Greece into Egypt, thence travelled eastward, forming settlements on the banks of the Euphrates and Tigris; and ultimately reached the Indus and Ganges. In craniological and facial characteristics, many Hindoos present a striking similitude to the ancient Greek, modified by climate, food, and habits; and in several architectural structures, of which ruins are still extant, there

testimony, however, that before the Christian era the country was thickly inhabited by a civilized people, dwelling in a well-cultivated territory, divided into numerous flourishing states, with independent governments, united in federal alliance, and capable of bringing into the field armies of several hundred thousand men.

For more than a thousand years after the Greek invasion, we have no knowledge of what was taking place among the population of India, and but a scanty notice, in the eighth century, of the Arab incursions of the regions bordering on the Indus. Even the marauding forays of Mahmood the Ghasnevide, in the eleventh century, afford no internal evidence of the state of the people, save that derived from a record of their magnificent cities, stately edifices, immense temples, lucrative trade, and vast accumulations of wealth; the Hindoos were probably then in a more advanced state of social life, though less warlike, than during the Alexandrine period: they had gradually occupied the whole of India with a greatly augmented population, and possessed a general knowledge of the arts, conveniences, and luxuries of life.

During the desolating periods of Moslem forays, and of Mogul rule, there appears to have been a continued diminution of men and of wealth, which Akbar in vain essayed to check by some equitable laws. We have sufficient indirect and collateral evidence to show that whole districts were depopulated, that famines frequently occurred, and that exaction, oppression, and misgovernment produced their wonted results in the deterioration of the country. No census, or any trustworthy attempt at ascertaining the numbers of their subjects was made by the more enlightened Mogul sovereigns, even when all their energies were directed to the acquisition of new dominions.

The English, until the last few years, have been as remiss in this respect as their predecessors in power. An idea prevailed that a census would be viewed suspiciously as the prelude to a capitation tax, or some other exaction or interference with domestic affairs. In Bengal, Bahar, and Orissa, which we have had under control for nearly a century, no nearer approximation has yet been made to ascertain the number of our subjects, than the clumsy and inaccurate contrivance of roughly ascertaining the houses and huts in a village or district, and then supposing a fixed number of mouths in each house (say five or six). The fallacy of such estimates is now admitted, and rulers are beginning to see the value of a correct and full census, taken at stated intervals, in order to show the rate of increase or decrease, and to note the causes thereof. I believe that the Anglo-Indian Government have no reason to apprehend unpleasing disclosures if a decennial census be adopted for all the territories under their sway: the natural fecundity of the Hindoos would lead to an augmentation where peace and the elements of animal sustenance exist; and a satisfactory proof would be afforded of the beneficence of our administration, by the multiplication of human life. With these prefatory remarks, I proceed to show briefly all that is at present known on the subject.

In the returns collected by Mr. Edward Thornton, head of the statistical department of the East India House, there must be erroneous estimates somewhere, otherwise there would not be so great a disproportion of mouths to each square mile, as appears between the British territories (157) and the other states (74)—105,000,000 on 666,000 square miles, and 53,000,000 on 717,000 square miles. Estimating the entire area, as above, at 1,380,000 square miles, and the population thereon at 158,000,000, would give 114 to each square miles. Viewing India, as including the entire region, from the Suliman on the west,

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is considerable resemblance to the ancient buildings of Egypt, and those erected on the Babylonian plains. Bryant is of opinion that Chaldea was the parent country of the Hindoos; Vans Kennedy traces the Sanscrit language to Mesopotamia; H. H. Wilson deems that the Hindoos connected with the *Rig Veda* were from a northern site, as in that work the worshipper on more than one occasion, when soliciting long life, asks for a hundred winters, which the Professor thinks would not have been desired by the natives of a warm climate. This is not conclusive. In Britain man frequently dates his age from the number of summers he has seen. There can, however, be little doubt that many of the early invaders of India were of the tribe of Japhet,—some of them acquainted with maritime commerce, and all comparatively more civilized than the *indigenes* who were driven towards the southward and eastward, and to mountain and jungle fastnesses. When this occurred it is impossible to determine. General Briggs says that the *Vedas* were written in India at the period when Joshua led the Israelites over Jordan into Canaan. The date when Menu, the lawgiver, lived has not yet been ascertained. Whatever the period, the Hindoos had not then occupied the country farther south than the 23rd degree, as Menu describes the people beyond as "barbarians, living in forests, and speaking an unknown "language." Remote annals are lost in legends and traditions; and the chronology of Hindooism is an absurdity, except on the principle of cutting off the ciphers attached to the apocryphal figures.

to the Youmadoung mountains on the east, and from Cape Comorin to Peshawur, and estimating the area at 1,500,000 square miles, and the number of inhabitants to each square mile at 130, would show a population of 195,000,000; which is probably not far from the truth.

The Chinese census shows 367,632,907 mouths on an area of 1,297,999 square miles, or 283 to each square mile.* In England the density is 333; Wales, 134; Ireland, 200; Scotland, 100.† India, with its fertile soil, a climate adapted to its inhabitants, and with an industrious and comparatively civilized people, might well sustain 250 mouths to each square mile, or 375,000,000 on 1,500,000 square miles of area.‡

The following table, framed from various public returns and estimates, is the nearest approximation to accuracy of the population of each district under complete British rule; it shows (excluding Pegu) a total of about 120,000,000 (119,630,098) persons on an area of 829,084 square miles, or 146 to each square mile;—

British Territories in Continental India—Area, Chief Towns, and Position.

Provinces, Districts, &c.	Area in Square Miles.	Population.	Principal Town.	Position of Town.		Date of Acquisition.
				Lat. N.	Long. E.	
				° ′	° ′	
BENGAL PROVINCE:—						
Calcutta and 24 Pergunnas	1,186	701,182	Calcutta	22 34	88 26	1700 & 1757
Hooghly	2,089	1,520,840	Hooghly	22 55	88 23	1757 & 1765
Nuddea	2,942	298,736	Kishnugur	23 24	88 28	1765
Jussore	3,512	381,744	Jessore	23 9	89 11	,,
Backergunge and Shabazpore	3,794	733,800	Burrisol	22 33	90 22	,,
Dacca	1,960	600,000	Dacca	23 43	90 25	,,
Tipperah and Bulloah	4,850	1,406,950	Tipperah	23 28	91 10	,,
Chittagong	2,560	1,000,000	Chittagong	22 20	91 55	,,
Sylhet and Jyntea	8,424	380,000	Sylhet	24 54	91 50	1835
Mymensing	4,712	1,487,000	Sowara	24 44	90 23	1765
Rajeshaye	2,084	671,000	Rampoor	24 33	88 38	,,
Moorshedabad	1,856	1,045,000	Berhampore	24 12	88 18	,,

* There have been several censuses of China, of which we have little reason to doubt the accuracy; that of 1753 showed 102,328,258; that of 1792, 307,467,200; that of 1812, 361,221,900. In some districts, along river banks, the density is very great, such as Kangsoo (Nankin)—774 to the square mile; in others the density varies from 515 down to 51. (*See* vol. i. p. 29, of my report on China to Her Majesty's Government, in 1847.)

† *See* Preface (p. xv.) to my Australian volume, new issue, in 1855, for density of population in different European States.

‡ In illustration of this remark, the following statement, derived from the Commissioners' Report on the Punjab,—of the population of Jullundhur Zillah, situated between the rivers Sutlej and Beas,—is subjoined, with the note appended by the census officer, Mr. R. Temple, 25th of October 1851.

Pergunnahs	Hindoo.		Mussulman.		Total.		Grand Total.	Total Area in Acres.	Area in Sq. Mile of 640 Acres each.	Number of Inhabitants per Sq. Mile.	Number of Acres to each Person.
	Agricultural.	Non-Agricultural.	Agricultural.	Non-Agricultural.	Agricultural.	Non-Agricultural.					
Philor	41,997	38,591	20,442	19,211	62,439	57,802	120,241	187,001	299	412	1·52
Jullundhur	48,967	49,652	46,049	50,568	95,016	100,220	195,236	250,397	391	499	1·25
Rahoon	42,739	47,201	25,145	19,027	67,884	66,228	134,112	199,472	312	430	1·48
Nakodur	28,787	19,349	44,085	26,181	72,872	45,530	118,402	225,031	351	337	1·80
Total	162,490	154,793	135,721	114,987	298,211	269,780	567,991	861,901	1,346	422	1·55

Note.—This return certainly shows a considerable density of population. It may of course be expected that a small and fertile track like this, which contains no forest, waste, or hill, should be more thickly peopled than an extensive region like the north-western provinces, which embraces every variety of plain and mountain, of cultivation and jungle; we find therefore that in the provinces we have 322 inhabitants per square mile, while here we have one-fourth more, or 422; the population of this district proportionately exceeds that of 22 out of 31 districts of the north-western provinces, and is less than that of nine. It also exceeds the average population of any one out of the six divisions. It about equals that of the districts of Agra, Muttra, Furruckabad, and Cawnpore, but is inferior in density to the populous vicinities of Delhi or Benares, and to the fertile districts of Juanpoor, Azeemgurh, and Ghazeepoor. The comparative excess of Indian over European population has become so notorious, that it is superfluous to comment on the fact, that the population averages of this district exceed those of the most highly peopled countries of Europe.

British Territories in Continental India—Area, Chief Towns, and Position—*cont.*

Provinces, Districts, &c.	Area in Square Miles.	Population.	Principal Town.	Position of Town.		Date of Acquisition.
				Lat. N.	Long. E.	
Bengal Province—*cont.*				° ′	° ′	
Beebhoom	4,730	1,040,876	Sooree	23 53	87 31	1765
Dinagepoor	3,820	1,200,000	Dinagepore	25 34	88 38	,,
Rungpoor	4,130	2,559,000	Rungpoor	25 40	89 16	,,
Burdwan	2,224	1,854,152	Burdwan	23 12	87 56	1760
Baraset	1,424	522,000	Baraset	22 43	88 33	,,
Bancoorah	1,476	480,000	Bancoorah	23 14	87 6	,,
Bhagulpore	5,806	2,000,000	Bhagulpore	25 11	87 0	1765
Monghyr	2,558	800,000	Monghyr	25 19	86 30	,,
Maldar	1,000	431,000	Maldah	25 2	88 11	,,
Bagoorah	2,160	900,000	Bagoorah	24 50	89 25	,,
Pubna	2,606	600,000	Pubna	24 0	89 12	,,
Purneah	5,878	1,600,000	Purneah	25 46	87 34	,,
Fureedpore, Deccan, and Jelalpore	2,052	855,000	Fureedpore	23 36	89 50	,,
Darjeeling	834	30,882	Darjeeling	27 2	88 19	1835 & 1850
Singhbhoom	2,944	200,000	Chaibassa	22 36	85 44	1765
Maunbhoom	5,652	772,340	Pachete	23 36	86 50	,,
South West Frontier:—						
Chota Nagpore	5,308	482,900	Lohadugga	23 6	84 46	1818
Palamow	3,468		Palamow	23 50	84 1	,,
Bahar Province:—						
Ramghur	8,524	372,216	Ramghur	24 0	85 24	1765
Behar	5,694	2,500,000	Gyah	24 43	85 2	,,
Patna	1,828	1,200,000	Patna	25 53	85 16	,,
Shahabad	3,721	1,600,000	Arrah	25 31	84 43	1775
Tirhoot	7,402	2,400,000	Mozufferpoor	26 6	85 28	1765
Sarun and Chumparun	2,560	1,700,000	Sarun or Chupra	25 45	85 48	,,
Sumbhulpoor	4,693	800,000	Sumbhulpoor	21 29	84 0	1850
Orissa Province:—						
Midnapore and Hidgellee	5,029	666,328	Midnapore	22 25	87 23	1760
Cuttack and Pooree	4,829	1,000,000	Cuttack	20 28	85 55	1803
Balasore	1,876	556,395	Balasore	21 30	87 0	,,
Koordah	930	571,160	Koordah	20 10	85 43	,,
Madras Presidency:—						
Ganjam	6,400	926,930	Ganjam	19 24	85 7	1765
Vizagapatam	7,650	1,254,272	Vizagapatam	17 41	83 21	,,
Rajamundry	6,050	1,012,036	Rajamundry	17 0	81 50	,,
Masulipatam	5,000	520,866	Musulipatam	16 10	81 12	1759
Guntoor	4,960	569,968	Guntoor	16 20	80 30	1788
Bellary	13,056	1,229,599	Bellary	15 9	76 59	1800
Cuddapah	12,970	1,451,921	Cuddapah	14 28	78 52	,,
North Arcot	6,800	1,485,873	Chittoor	13 12	79 9	1751
South Arcot	7,610	1,006,005	Cuddalore	11 42	79 50	,,
Chingleput and Madras	3,050	1,283,462	Madras	13 6	80 21	1765
Salem	8,200	1,195,367	Salem	11 39	78 14	1792
Coimbatore	8,280	1,153,862	Coimbatore	11 0	77 2	1799
Trichinopoly	3,000	709,196	Trichinopoly	10 48	78 46	1801
Tanjore	3,900	1,676,068	Tanjore	10 48	79 11	1799
Madura	10,700	1,756,791	Madura	9 55	78 10	1801
Tinnivelly	5,700	1,269,216	Tinnivelly	8 44	77 44	1801
Malabar	6,060	1,514,909	Calicut	11 15	75 50	1792
Canara	7,720	1,056,333	Mangalore	12 52	74 54	1799
Nellore	7,930	935,690	Nellore	14 27	80 2	1801
Kurnool	3,243	273,190	Kurnool	15 50	78 5	1838
Coorg	1,420	65,437 in 1836	Mercara	12 27	75 48	1834
Bombay Presidency:—						
Concan, North	5,477	815,849	Tannah	18 57	72 53	1818
,, South	3,964	665,238	Rutnagheriah	17 0	73 20	,,
Bombay Island	18	566,119	Bombay	18 57	72 52	1661
Dharwar	3,837	754,385	Dharwar	15 28	75 4	1818
Poona	5,298	666,006	Poona	18 31	73 53	,,
Kandeish	9,311	778,112	Malligaum	20 32	74 30	,,
Surat	1,629	492,684	Surat	21 9	72 51	1759
Broach	1,319	290,984	Broach	21 42	73 2	1803
Ahmednuggur	9,931	995,585	Ahmednuggur	19 6	74 46	1817
Sholapore	4,991	675,115	Sholapore	17 40	76 0	1818
Belgaum	5,405	1,025,882	Belgaum	15 50	74 36	1817
Kaira	1,869	580,631	Kaira	22 43	72 40	1803
Ahmedabad and Nassik	9,931	995,585	Ahmedabad	23 0	72 36	1818
Sattara	10,222	1,005,771	Sattara	17 40	74 3	1848
Berar Province:—						
Deogur above the Ghauts	76,432	4,650,000	Chindwara	22 3	78 58	1854
Deogur below the Ghauts			Nagpore	21 10	79 10	,,
Wein-Gunga			Bundara	21 11	79 41	,,
Choteesgurh			Ryepore	21 11	81 40	,,
Chandarpoor			Chandah	19 57	79 23	,,

British Territories in Continental India—Area, Chief Towns, and Position—*cont.*

Provinces, Districts, &c.	Area in Square Miles.	Population.	Principal Town.	Position of Town.		Date of Acquisition.
				Lat. N.	Long. E.	
				° ′	° ′	
NERBUDDA DISTRICTS:—						
Saugor	1,857	305,594	Saugor	23 50	78 49	1818
Jubbulpoor	6,237	442,771	Jubbulpoor	23 10	80 1	„
Hoosungabad	1,916	242,641	Hoosungabad	22 44	77 44	„
Seuni	1,459	227,070	Seuni	22 1	79 40	„
Dumoh	2,428	363,584	Dumoh	23 49	79 30	„
Nursingpoor	501	254,486	Nursingpoor	24 0	79 28	„
Baitool	990	93,441	Baitool	21 50	77 58	„
AGRA PRES., OR N.W. PROVINCE:—						
Benares	995	851,757	Benares	25 17	83 4	1775
Ghazeepore	2,181	1,596,324	Ghazeepore	25 32	83 39	„
Azimghur	2,516	1,653,251	Azimghur	26 0	83 14	1801
Goruckpoor	7,340	3,087,874	Goruckpoor	26 42	83 24	„
Jounpoor	1,552	1,143,749	Jounpoor	25 44	82 45	1775
Allahabad	2,788	1,379,788	Allahabad	25 26	81 45	1801
Banda	3,009	743,872	Banda	25 27	80 93	1803
Futtehpore	1,583	679,787	Futtehpore	25 57	80 54	1801
Cawnpore	2,348	1,174,556	Cawnpore	26 29	80 25	„
Etawah	1,677	610,965	Etawah	26 46	79 5	„
Furruckabad	2,122	1,064,607	Furruckabad	27 24	79 40	„
Shajehanpoor	2,368	986,096	Shajehanpoor	27 52	79 58	„
Allyghur	2,153	1,134,565	Allyghur	27 56	78 8	1817
Bareilly	3,119	1,378,268	Barcilly	28 23	79 29	1801
Moradabad	2,698	1,138,461	Moradabad	28 50	78 51	„
Agra	1,864	1,001,961	Agra	27 10	78 5	1803
Delhi	789	435,744	Delhi	28 38	77 19	„
Saharunpoor	2,162	801,325	Saharunpoor	29 58	77 36	„
Paniput	1,269	389,085	Paniput	29 23	77 2	„
Hissar	3,294	330,852	Hissar	29 8	75 50	„
Rohtuk	1,340	377,013	Rohtuk	28 54	76 38	„
Goorgaon	1,939	662,486	Goorgaon	28 28	77 5	„
Mozuffernuggur	1,646	672,861	Mozuffernuggur	23 28	77 45	1836
Meerut	2,200	1,135,072	Meerut	28 59	77 46	„
Boolundshuhur	1,823	778,342	Burrun	28 24	77 56	1803
Bijnore	1,900	695,521	Bijnore	29 22	78 11	1802
Budaon	2,401	1,019,161	Budaon	28 2	78 11	„
Mutira	1,613	862,909	Muttra	27 30	77 45	1803
Mynpoory	2,020	832,714	Mynpoory	27 14	97 4	„
Humeerpoor	2,241	548,604	Humeerpoor	25 58	80 14	1802
Mirzapoor	5,152	1,104,315	Mirzapoor	25 6	82 38	1801
Jaloun	1,873	176,297	Jaloun	26 9	74 24	„
Ajmere	2,029	224,891	Ajmere	26 29	74 43	1817
Mairwarra	282	37,715	Nyanugga	26 6	74 25	„
CIS SUTLEJ:—						
Umballah	293	67,134	Umballah	30 24	76 49	1847
Loodianah	725	120,898	Loodianah	30 55	75 54	„
Kythul and Ladwa	1,538	164,805	Kythul	29 49	76 28	1843
Ferozepore	97	16,890	Ferozepore	30 55	75 55	1835
Seik States	1,906	249,686	Patialah	30 20	76 25	„
PUNJAB:—						
Jhelum	13,959	1,116,035	Jhelum	32 56	73 47	1849
Lahore	13,428	2,470,817	Lahore	31 36	74 21	„
Leia	30,000	1,500,000	Leia	30 57	71 4	„
Mooltan	14,900	500,000	Mooltan	30 12	71 30	„
Jullunder	1,324	569,722	Jullunder	31 21	75 31	1846
Peshawur	4,836	about	Peshawur	34 71	71 38	1849
Kangra		850,300	Kangra	32 5	76 18	„
SCINDE PROVINCE:—						
Kurrachee	16,000	185,550	Kurrachee	24 56	67 3	1843
Shikarpoor	6,120	350,401	Shikarpoor	28 1	68 39	„
Hydrabad	30,000	551,811	Hydrabad	25 12	69 29	„
ULTRA-GANGETIC DISTRICTS:—						
Arracan	15,104	321,522	Akyab	20 10	92 54	1826
Assam, Lower	8,948	710,000	Gowhatty	26 9	91 45	„
Assam, Upper	12,857	260,000	Seebpore	27 0	94 40	„
Goalpara	3,506	400,000	Goalpara	26 8	90 40	1765
Cossya Hills	729	10,935	Chirraponjee	25 14	91 45	1826
Silchar	4,000	60,000	Silchar	24 49	92 50	1830
Tenasserim, Mergui, Ye, &c.	29,168	115,431	Mergui	12 27	98 42	1826
Pegu Province	25,000	550,000	Prome	17 40	96 17	1853

A more recent return (28th July 1855) from the East India House, gives the population of India thus:—

British States.—Bengal, &c., 59,966,284; N.W. Provinces, 30,872,766; Madras, 22,301,697; Bombay, 11,109,067; Eastern settlements, 202,540: Total, 124,452,354.

Native States.—Bengal, 38,259,862; Madras, 4,752,975; Bombay, 4,460,370: Total, 47,473,207.

Foreign States.—French settlements, 171,217; Portuguese ditto, not known. Grand total, 172,096,778.*

The varying degree of density of population to area forbids reliance being placed on any mere "estimates," or "approximations to actual amount." Thus in Bengal, Behar, and Cuttack, the number of mouths to each square mile is stated to be—in Jessore, 359; Moorshedabad, 394; Bhagulpoor, 318; Patna, 506; Cuttack, 220; Dacca, 193; Chittagong, 324; average of all, 324.† These are high ratios; but the soil is fertile, and the inhabitants very numerous along the banks of rivers. In Assam, on the N.E. frontier of Bengal, and along the rich valley of the Brahmapootra, the density is placed at only 32 to the square mile; in Arracan, at 21; Tenasserim provinces, at 4; on the S.W. frontier (Chota Nagpoor, &c.), at 85; in the Saugor and Nerbudda territories, at 109; in the non-regulation provinces, Kumaon, Ajmere, &c., at 44.

The census of the Madras presidency shows, on an area of 138,279 sq. m., a population of 22,281,527, or 161 persons to each sq. m. In some districts the inhabitants are much more thinly scattered: for instance, at Kurnool, 84; at Bellary, 94; at Masulipatam, 104; the highest is the rich district of Tanjore, with 430 to each sq. m. Madras has a much less density than the British N.W. Provinces, which, according to the return of 1852–3, shows the following results:‡—

Districts.	Square M.	Population.	Mouths to each sq. m.
Agra - - - -	9,298	4,373,156	465
Allahabad - - - -	11,971	4,526,607	378
Benares - - - -	19,737	9,437,270	478
Delhi - - - -	8,633	2,195,180	254
Meerut - - - -	9,985	4,522,165	453
Rohilcund - - - -	12,428	5,217,507	419
Total -	72,052	30,271,885	420

By the two full censuses of Madras and the N.W. Provinces, we gain at last a fair estimate of the small number of Mohammedans, as compared with the Hindoos, in India: the Madras census of 1850–1 shows, on a total of 21,581,572 that the *adult* Hindoos numbered 13,246,509; Mohammedan adults and others 1,185,654: the *children*—Hindoos, 6,655,216; Mohammedans and others

* The sum of 124,452,354 is a higher figure than the Anglo-Indian subjects of the British Crown have hitherto been rated, and is probably the result of a more accurate numbering of the people; thus, until a census now (July 1855) in progress was made of the Punjab, the population was, as usual, under-estimated. According to the *Lahore Chronicle* of 30th of May 1855, the returns then received show for Lahore, 3,458,322; Jhelum, 1,762,488; Cis-Sutlej, 2,313,969; which are higher figures than those given from the Parliamentary Papers. The enumerations made up to May last for the Punjab gave 10,765,478; and it was supposed that the grand total, when completed, would be about eleven millions and a half, or nearly four millions more than the official document previously given for the Punjab and Cis-Sutlej states. In my first work on India, twenty years ago, I assumed the population under British jurisdiction to be about one hundred millions, which some considered an exaggeration; the above augmentation of twenty-four millions is accounted for by the addition of new states, such as the Punjab. I have little doubt that an accurate census will show a larger aggregate than 124,000,000.

† I obtained in India, in 1830, "a census" or rather estimate of these districts, showing an aggregate of area in square miles, 153,792; villages, 154,268; houses, 7,781,240; mouths, 39,957,561; or about one village to each square mile of 640 acres, five houses to each village, five and a half persons to each house, and 259 mouths to each square mile. (*See* first *History of the British Colonies*, vol. i., Asia; 2nd edition, p. 166; published in 1835.)

‡ As regards the censuses of Madras and the N.W. Provinces, I have seen no details given of the means adopted to ensure an accurate enumeration in a single day; they must, I think, be considered as "near approximations" to truth; they appear to be the best yet obtained.

594,193: total census (exclusive of Madras city and suburbs, containing 700,000)—

Class.	Males.	Females.	Total.
Hindoos - - - -	10,194,098	9,707,627	19,901,725
Mohammedans and others - -	852,978	826,869	1,679,847
Total -	11,047,076	10,534,496	21,581,572

The proportion of Moslems to Hindoos in Southern India, is as 1 to 10. The N.W. Provinces return, in 1852–3, shows—

Class.	Males.	Females.	Total.
Hindoos - - - -	13,803,645	11,920,464	25,724,109
Mohammedans and others - -	2,376,891	2,170,880	4,547,771
Total -	16,180,536	14,091,344	30,271,880

Mountains.

Himalaya, or "Abode of Snow."

This stupendous mass extends in an irregular curve over 22° of lon., from the defile above Cashmere, where the Indus penetrates into the plains of the Punjab, lon. 73° 23′, to the S. bend of the Sanpoo, lon. 95°23′. It is 1,500 m. long, with an avg. breadth of 150 m.

Elevation above the Sea.—1. Dairmal, 26,629 ft.; 2. Bal Tal, 17,839; 3. Ser and Mer, 23,447; 4. Hanle, 20,000; 5. Gya, 24,764; 6. Porgyal, 22,600; 7. Raldang, 20,103; 8. St. Patrick, 22,798; 9. St. George, 22,654; 10. The Pyramid, 21,579; 11. Gangoutri, 22,906; 12. Jumnoutri, 21,155; 13. Kedarnath, 23,062; 14. Badrinath, 22,954; 15. Kamet, 25,550; 16. Nanda Devi, 25,749; 17. Gurla, 23,900; 18. Dhawalagiri, 27,600; 19. Gonsainthan, 24,740; 20. Junnoo, 25,311; 21. Kinchinjunga, 28,176; 22. Chomiomo, 19,000; 23. Kanchan Jhow, 22,000; 24. Chumalari, 23,929; 25. Three peaks on lower bank of Deemree, 21,000; 26. Kailas, 22,000. Average elevation, 18,000 to 20,000 ft. M. Everest, 29,002.

Limit of perpetual snow, or congelation on S. slope. 15,000 to 18,000 ft. Deep narrow valleys, separated by ranges running either parallel or at right angles with the main ridge, contain the numerous sources of the rivers flowing into the Ganges, the Indus, and the Brahmapootra.* The steep face is towards the plain, and to the N. the chain supports the lofty table-land of Tibet. The greater part of the giant peaks, which rise to an elevation of 25,000 or 28,000 ft., are situate not on the central axis, but to the south of it. Viewed from Patna, at a distance of about 150 miles, these mountains present a long line of snow-white pinnacles, which, on a nearer approach, are seen towering above the dark line of lower but still lofty mountains.† With the exception of a strip of land at the foot of the mountains, the whole of Bootan presents a succession of the most lofty and rugged mountains on the surface of the globe. It is a series of ridges, separated only by the narrow beds of roaring torrents.

HindooKoosh,‡ Kouenlun, or Mooz Taugh.

About 850 m. long. From Kara-korum, lat. 35°, lon. 77°; to Bamian,§ lat. 34° 50′, lon. 67° 48′.‖

Elevation.—1. Hindoo-Koosh, 35° 40′, 68° 50′, 21,000 ft.;¶ 2. Summit N. of Jelalabad, 20,248; 3. Koushan Pass, 15,200; 4. Khawak Pass, 13,200; 5. Akrobat, 10,200 feet. Laram Mountains, 35° 20′, 62° 54′: about 60 m. from N.E. to S.W., dividing the valley of Suwat from that of Panjkora; and Laspissor Mountains, S. of, and subordinate to, Hindoo-Koosh, about 50 m. from E. to W., 36°, 70°—little known.

Limit of perpetual snow on S. slope (lat. 37°), 17,000 ft. The most remarkable feature of Hindoo-Koosh is, that to the S. it supports the plains of Kabool and Koh-Damaun, 6,000 to 7,000 ft.; while to the N. lies the low tract of Turkestan. Koon-

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* The two sections of the Himalaya furnish points of resemblance, in presenting almost insurmountable obstacles to communication between the countries which they divide, thereby separating the Botis or people of Tibet from the Hindoo family of India. Major Cunningham considers the distinction of climate not less positively marked, both ranges forming the lines of demarcation between the cold and dry climate of Tibet, with its dearth of trees, and the warm and humid climate of India, with its luxuriance of vegetable productions. Some analogy, moreover, may be traced between the drainage systems of the two sections; the one separating the waters of the Samnpoo from those of the Ganges and its affluents; and the other intervening between the Indus, flowing at its northern base, and the subsequent tributaries of that river rising on its southern slope.

† Any view of the Himalaya, especially at a sufficient distance for the snowy peaks to be seen overtopping the outer ridges, is very rare, from the constant deposition of vapours over the forest-clad ranges during a greater part of the year, and the haziness of the dry atmosphere of the plains in the winter months. At the end of the rains, when the south-east monsoon has ceased to blow with constancy, views are obtained, sometimes from a distance of nearly 200 miles.

‡ It has often been observed, the Koh Kosh, or mountain of Kosh, offers a plausible etymology for the Caucasus of the classical writers. It is supposed by Ritter and Wilford to be the Mount mentioned by Pliny, under the name of *Graucasas*, but slightly deviating from the Sanscrit *Graveakasas* (shining rock).

§ All the series appear to diverge from the apex of the plain, expanding "like the sticks of a fan."

‖ Humboldt regards it as the "most striking phenomenon amongst all the mountain ranges of the "old world." He considers that it may be traced from Taurus, in Asia Minor, across Persia, then, in the Huzareh mountains, to Hindoo-Koosh, and to the frontier of China; and that it is distinct from the Himalaya. The two ranges are physically discriminated by the depression down which the Indus flows, which, with its numerous irregularities, it is not easy to believe could have been hollowed out by the water's force even of that great river.

¶ Remarkable for its mass and elevation. Viewed from the Koushan Pass, distant 10 miles south, its appearance is very sublime. The outline is serrated, being crowned by a succession of lofty peaks, with sides often perpendicular, and it is wrapped in a perpetual covering of snow, in all parts not too steep to admit its lying.

dooz town, distant in a direct line 80 m. N. of Hindoo-Koosh, only 900 ft. above the sea. The Hindoo-Koosh is a distinct mountain system, its parallelism being from S.W. to N.E., while that of the Himalaya is from S.E. to N.W.*

About 60 m.,—along lat. 34° 30′, between lon. 67° 30′, and 68° 30′. At the S.W. extremity of Hindoo-Koosh with which it is connected by the transverse ridges of Kalloo and Hajeguk. Koh-i-Baba.

Elevation.—Variously estimated. According to Burns and Lady Sale, 18,000 ft. ; Outram, 20,000 feet ; Humboldt, 2,800 toises, or 17,640 ft. ; the most probable is 16,000 ft. Highest accessible point, 34° 40′, 67° 30′ ; 13,200 ft. Hajeguk Pass, 11,700 ft.

It is a vast rounded mass, the culminating ridge ascending in lofty peaks, covered with perpetual snow, stretching as far as the eye can reach—further to the W. it sinks into the mazy mountains forming the Huzareh highlands. Supposed to be the Parapamissus of the Greeks.

Near Attock, lon. 72° 16′ to lon. 69° 36′, proceeding nearly along the parallel of lat. 33 ? 50′ ; then sinking into a maze of hills stretching to the Kohistan of Kabool. Sufied-Koh, Snowy or White Mountains.†

Elevation.—There are three ranges, running nearly parallel to the S. of the Kabool River ; they rise in height as they recede from the river, the highest between 69° 40′, and 70° 30′, attaining an altitude of 14,000 ft.

Covered with perpetual snow. Generally of primary formation, consisting of granite, quartz, gneiss, mica-slate, and primary limestone. The Soorkh Rood, the Kara Su, and many other shallow but impetuous streams rush down its northern face, and are discharged into the Kabool river, which conveys their waters to the Indus. The two lowest ranges are covered with pine forests; the highest and most distant has a very irregular outline, is steep and rocky, yet furrowed by many beautiful vales.

Subordinate to Hindoo-Koosh, running along its S. base, generally from N.E. to S.W. Pughman, or Pamghan Range.

Elevation.—Estimated at 13,000 ft. Oona Pass, 34° 23′ and 68° 15′ ; 11,320 ft. Erat Summit, 34° 40′ and 68° 48′ ; 12,480 ft.

Always covered with snow. Its south-eastern brow overhangs the delightful region of Koh-Damaun and also Kabool ; its northern face forms the southern boundary of the Ghorbund valley.

Separates the valley of Kabool from plain of Jelalabad ; and connects the Hindoo-Koos with Sufied Koh. Kurkutcha Mountains.

Elevation.—From 1,000 to 2,000 ft. above Kabool, and the highest part, 34° 25′ and 69° 30′ ; 8,000 ft. above the sea.

Four routes over this range practicable only for a man and horse ; at Lattabund Pass, 4,000 British troops were destroyed in their retreat, in 1842. Cold intense during winter, the frost splitting the rocks into huge fragments.

Length, about 50 m. ; breadth, about 20 m. Between 33° 30′ and 34° 20′, and 71° 10′ and 71° 30′. They connect Hindoo-Koosh with Sufied Koh. Khyber Mountains.

Elevation.—Tartara summit, highest point, 4,800 ft. Summit of Khyber Pass, 3,373 ft.

Appear at first irregularly grouped, but the distinct arrangement of a chain is afterwards observable, Four passes through this range. The hills generally consist of slate and primary limestone, with overlying sandstone.

Lat. 33° 22′, lon. 67° 50′ ; 30 m. S.W. from Ghuznee. Goolkoo Mountains.

Elevation.—Estimated at 13,000 ft.

Lat. 30° 50′, lon. 66° 30′. Amran Mountains.

Elevation.—General elevation, about 8,000 ft. Highest part, 30° 50′ and 66° 30′ ; about 9,000 ft. Kojuck Pass, 7,457 ft.

Bounds the table lands of Shawl and Pisheen on the W., as the Hala range does to the E.

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* "The elevated expanse of Pameer," to the north of Hindoo-Koosh, observes Humboldt, "is not "only a radiating point in the hydrographical system of Central Asia, but is the focus from which "originate its principal mountain chains, being common to India, China, and Turkestan ; and from it, "as from a central point, their several streams diverge."

† The country between Sufied-Koh and Hindoo-Koosh is hilly ; breadth about 20 m. It is divided into a series of plains by cross ranges (Khyber, Kurkutcha, &c.), which pass between Sufied-Koh and the outer ranges of Hindoo-Koosh. These plains are generally barren and stony, and have a slope from E. to W. The Kabool river, which flows through them, has to make its way by narrow passages.

Toba Mountains. Length, 150 m. Between 30° 40′ and 32° 40′, and 66° 40′ and 68° 20′; extending N.E. from the N. side of Pisheen valley.

Elevation.—General elevation, 9,000; above Pisheen, 3,500 ft. Tukatoo Hill 30° 20′ and 66° 55′; 11,500 ft.

Country, though generally rugged, fertile.

Pubb Mountains. Length, about 90 m. from C. Monze to lat. 26°.

Elevation.—Supposed to equal those of W. Scinde, viz., 2,000 feet. Highest part, about 25° 30′.

In 25° 3′ and 66° 50′, they are crossed by the Guncloba Pass, described as stony, and of easy ascent and descent.

Scinde Ranges, viz.:—

1. Jutteel. 60 to 70 m. S.W. from Sehwan to Dooba. Between 25° 32′, 26° 20′, and 67° 48′, 68° 8′.

Elevation.—Steep—in few places less than 2,000 ft.

The road from Sehwan to Kurrachee lies between them, and Keertar more to the W.

2. Keertar. Parallel with the Jutteel, more to the W., between 25° 50′, 26° 40′, and about 67° 40′.

Elevation.—Average height, probably below 2,000 feet.

Imperfectly explored.

3. Lukkee. Length, about 50 m. From Jutteel, S.E. towards Hydrabad. Centre of range, 26°, 67° 50′.

Elevation.—Highest part, 1,500 to 2,000 feet. Between Lukkee and Sehwan the mountains have a nearly perpendicular face, towards the Indus, above 600 ft. high.

They are of recent formation, and contain a profusion of marine exuviæ. Huge fissures traverse this range, and hot springs and sulphureous exhalations are of frequent occurrence.

Hala, Brahooick, or Bolan Range. Length, about 400 m. From Tukatoo to Arabian Gulf, forming the E. wall of Beloochistan table-land.

Elevation.—Average height, 5,000 to 6,000 ft. Kurklekee Mountains, that part which borders on the Bolan Pass, from 29° 20′ to 30° 10′, and 67° to 67° 30′, where the crest of Bolan Pass intersects them, 5,793 ft.

The range is crossed by the Bolan Pass, through which the route lies from Shikarpoor to Kandahar and Ghuznee, and though important in a military point of view, inferior in commercial interest to the Goolairee, farther N.

Suliman Range. Length, about 350 m. From 33° 40′, they run nearly S. in the 70th meridian of lon. to the mountains about Hurrund and Kahun, in lat. 29°.

Elevation.—Highest elevation, Takht-i-Suliman, called also Khaissa-Ghar, lat. 31° 35′; 11,000 ft.

E. face dips rather steeply to the Indus, but the W. declivity much more gradual, to the table-land of Sewestan. Sides of mountains clothed nearly to the summits with dense forests; valleys overgrown with a variety of indigenous trees, shrubs, and flowers.

Kala, or Salt Range. Stretch from the E. base of Suliman Mountains to Jhelum River, N.E. to S.W., in lon. 32° 30′ to 33° 30′.

Elevation.—Highest elevation, 2,500 ft.

Vegetation scanty; the bold and bare precipices present a forbidding aspect. About 32° 50′, 71° 40′, the Indus makes its way down a narrow rocky channel, 350 yards broad; and the mountains have an abrupt descent to the river.

Sewalik Range. Length, 155 m., greatest breadth, 10 m. From Hurdwar to Roopur, S.E. to N.W.

Elevation.—From 3,000 to 3,500 ft.; highest part, 30° 17′, and 77° 50′, between the Timli and Lal Derwaza Passes.

In many places each hill might be represented by a right-angled triangle, the base resting on the pass, perpendicular facing towards the plains; hypothenuse sloping towards the Dhoons, in the opposite direction.

Nepaul Mountains and Table-land. 500 m., breadth from 90 to 150 m. From Kumaon to Sikhim.

Elevation.—Diversified by several inhabited valleys, elevated from 3,000 to 6,000 ft. above the plains of Bengal. The hills rise towards the culminating ridge of the Himalayas. Katmandoo, 4,628 ft. above sea, in a valley surrounded by stupendous mountains.* Bynturee, 29° 35′, and 79° 20′; 5,615 ft.

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* Valley of Catmandoo, nearly of oval shape; length, N. to S., 12 m.; E. to W., about 10 m. Bounded on the N. and S. by stupendous mountains. To the E. and W. by others less lofty, the western end defined principally by a low steep ridge, called Naga-Arjoon, which passes close behind

Hills consist of limestone, hornstone, and conglomerate. Nepaul, owing to its elevation, enjoys a climate resembling that of S. Europe. Snow lies on the mountain-chain which surrounds the capital, in winter, and occasionally falls in the valley. The whole region is well watered.

Arravulli Range.

Length, 200 m.; average breadth, 10 to 15 m. Extent from 22° 40′ to 26° 50′, and from lon. 74° to 75°.

Elevation.—Average, 3,000 ft. Highest elevation, Mt. Aboo, 5,000 ft. Crest of Koulmair Pass, 3,353 ft. Twelve m. from Beawr; country one mass of hills, intersected by small vales.

Forms the western buttress of a plateau of Central India. The mountains at Pokur are of a rose-coloured quartz, displaying bold pinnacles and abrupt rocky sides. The geological formation of Mt. Aboo is granitic.

Kattywar Mountains.

The peninsula lies between 20° 42′, 23° 10′, 69° 5′, 72° 14′; area, 19,850 sq. m.

Elevation.—The Gir, a succession of ridges and hills, some 1,000 ft.; elevation diminishing towards N. Girnar, a granitic peak, 3,500 ft. Palithana Mt., 1,500 ft. Group near Poorbunder, 2,000 ft. Low ridge running from Choteyla to Gir, 400 ft. The centre of peninsula is the highest, and here all the rivers take their rise.

Caverns, deep ravines, and other fastnesses, very numerous in the Gir. The base of Girnar Mt. is clothed with jungle. diversified with black rocks, which appear through the vegetation. After this, the mount rises an immense bare and isolated granite rock, the face being quite black, with white streaks; and the N. and S. sides nearly perpendicular scarps.*

Vindhya Chain.

From Guzerat on the W. to the basin of the Ganges on the E.; and comprised between the 22nd and 25th parallels of latitude.

Elevation.—Average height 1,500 to 2,000 ft. Chumpaneer, 22° 31′, 73° 41′; 2,500 ft. Crest of Jam Ghaut, 2,300 ft.† Mountain in Bhopal, 2,500 ft. Mahadeo Mountains, between 21° 30′, 22° 40′, and 78° 80′; Doulagheree, said to be the highest; Ambarmarph, estimated at 2,500 ft. Chindwarra, 2,100 ft.; and Patchmaree, vaguely stated to be 5,000 ft.; but this is probably an exaggeration; Dokgur, stated to be 4,800 ft.; Putta Sunka, and Choura Doo the highest, conjectured at 5,000 ft. Amarkantak, a jungly table-land, computed to be 3,463 ft. Leela, a summit in Lanjhee hills, 21° 55′, 80° 25′, 2,300 ft.; another of the same hills, in 21° 40′, 80° 35′, 2,400 ft.

The chain forms the southern buttress of the plateau of Malwa, Bhopal, &c. In the Saugor and Nerbudda territories, its crest is but the brow of this table-land; but in the western part it rises a few hundred feet above the high land on its northern side. The Passes that have been made over this range are, for the most part, bad. The geological formations are granitic and sandstone, overlaid by trap rock.

Bundelcund Ranges, three, viz.:—

1. Bindyachal.

Commences near Seundah, lat. 26° 14′, lon. 78° 50′; proceeds S.W. to Narwar, 25° 39′, 77° 52′; S.E. to 24° 12′; N.E. to Ajegarh, 24° 53′, 80° 20′; and Kalleenjur, in the same vicinity, and E. to Barghar, 25° 10′, 81° 36′.

Elevation.—None more than 2,000 ft. Average between the Tara and Kuttra passes, about 520 ft. The Tons fall over the brow by a cascade of 200 ft.; Bilohi, 398 ft.; and Bouti, 400 ft.

The lower parts are primary, overlaid by sandstone, in many places trap, or other formations of volcanic origin. The plateau, which surmounts the range, is from 10 to 12 m. wide.

2. Panna.

Rises S. of the Bindyachal plateau.

Elevation.—Average elevation between Kuttra Pass and Lohargaon, 1,050 ft. Elevation between Lohargaon and the foot of the hills near Patteriya, about 1,200 feet.

Summit an undulating platform, about ten miles wide. Where deep ravines allow examination, an enormously thick bed of sandstone is found with primary rock superincumbent, itself overlaid by volcanic rocks.

Sumbhoo-Nath, and is backed by a more considerable one named Dhoahouk. To the eastward, the most remarkable hills are those of Ranichouk and Mahabut, but they do not reach the elevation of Phalchouk (the highest on the south), or of Sheopoori, which is by far the highest mountain. The bottom of the valley is uneven, intersected by deep ravines, and dotted throughout with little hills.

* The number of peaks which crown this mountain is variously stated. According to Tod, there are six, the most elevated of which is that of Gorucknath, having on its summit an area of only 10 feet in diameter, and surrounded by a shrine dedicated to Gorucknath; each of the other peaks has its shrine. On a small table-land on the mountain, about 600 feet below its summit, is the ancient palace of Khengar, and numerous Jain temples.

† Ascent from Indore (1,998 feet), gradual; descent, to the Nerbudda, steep and abrupt.

3. Bandair.

Separated from the Panna range by the valley of Lohargaon, rising from a platform from 10 to 20 m. wide.

Elevation.—Average elevation, 1,700; on some of its undulations, amounting to 2,000 ft.

Generally of sandstone, intermixed with ferruginous gravel. The basin of Lohargaon is of lias limestone. The outer limit of this hilly tract is marked by abrupt isolated hills.

Rajmahal Hills.

Rise about 20 m. S. of the Ganges; stretch S. and S.W. to the Vindhya range and the highlands of the Deccan. They terminate at the pass of Sikrigali.

Elevation.—Of moderate elevation. Cluster on the W. of the Phalgu, one on the E. of that river, a third near Shukpoora; 700 ft. Hills towards the S. probably twice that elevation. Railway sweeps round the eastern extremity of the range.

In the E. the rock is of trap; in one place there is a conical hill, having at the top a cavity resembling the crater of an extinct volcano. A neighbouring hill sends forth smoke, luminous at night. In the W. and S.W. the rock is of quartz, or coarse jasper and flint, containing ore of iron and lead.

Sirgoojah Mountains.

Length, 90 m.; breadth, 85 m. Lie between 22° 34′, 24° 54′, and 82° 40′, 84° 6′.

Elevation.—Rugged and mountainous, from 500 to 600 ft. above adjoining table-land of Chota Nagpore.

Drained by the rivers Kunher and Rhern, with its feeder the Mohan, flowing in a direction generally northerly. These rivers are mostly shallow, except during the rains, when they become rapid torrents.

Pachete Hills.

Length, 105 m.; breadth, 95 m. Lie between 22° 56′, 23° 54′, 85° 46′, 87° 10′.

Elevation.—Imperfectly known. N. part described as marked by hills from 400 to 600 ft. About 23° 35′, 85° 50′, a mountain conjectured at from 2,500 to 3,000 ft. Near the centre of district some hills about 900 ft.

Formation generally primitive, of either granite, gneiss, or sienite. Coal has been found near Jeria, 23° 44′, 86° 25′; and iron ore exists at a short distance. The chain unites the N. extremities of the W. and E. Ghauts, and forms the base of the triangle on which rests the table-land of S. India. By the Moguls the country to the N. was called Hindoostan, and that to the S. the Deccan.

Sautpoora Mountains.

Divides the Nerbudda from the Taptee valleys, extending from 21° and 22°, and 73° 40′, to 78°, when it becomes confounded with the Vindhya.

Elevation.—Average elevation, supposed, 2,500 ft. Asseerghur hill-fort, 1,200 ft. They form the northern base of the Deccanie table-land.

S. declivity towards Taptee abrupt; N. towards Nerbudda, gentle. The mountains rise into peaks, or swell into forms denoting a primitive origin. They are volcanic.

Western Ghauts, called by the natives Syadree in its N. part; and Sukheit in its S. part.—Malabar Coast.

Length, about 800 m. From about 21° 15′, to 73° 45′, and 74° 40′, where they terminate almost precipitously, forming the N. side of the Gap of Palgatcheri.

Elevation.—Average height, 4,000 ft. About 21°; 2,000 ft. Mahabulishwur, 18°, 73° 40′; 4,700 ft. Poorundher, 4,472 ft. Singhur, 4,162 ft. Hurreechundurghur, 3,894 ft. About 15°; 1,000 ft. Towards Coorg: Bonasson Hill, 7,000 ft. Tandianmole 5,781 ft. Papagiri, 5,682 ft.

Seaward face, though abrupt, not precipitous, but consists of a series of terraces or steps. Chasms or breaks in the range give access to the highlands, and are denominated ghauts or passes, a name which has become generally applied to the range itself. The core is primary, inclosed by alternating strata of more recent origin. Scenery delightful and grand, displaying stupendous scarps, fearful chasms, numerous waterfalls, dense forests, and perennial verdure.

Neilgherry Group.

Length, about 50 m.; breadth, about 20 m.; area from 600 to 700 sq. m. Between 11° 10′ and 11° 35′, and 76° 30′ and 77° 10′.

Elevation.—Elevation from 5,000 to 8,000 ft. Dodabetta, 8,760 ft. Kudiakad, 8,502 ft. Kundah, 8,353 ft. Duvursolabeta, 8,380 ft. Beroyabeta, 8,488 ft. Murkurti, 8,402 ft. Ootacamund, lat. 10° 50′; 7,361 ft. General surface, an undulating table-land.

The foundation rocks are primary. Principal mineral,—iron ore. Neither calcareous nor stratified rocks, nor organic remains are found. So steep are the precipices, that in many parts a stone dropped from the edge will fall several thousand feet without striking anything. Neilgherries, from "neil," blue, and "gherries," hills; blue hills.

Palghat Ghauts.

Length, about 200 m. From the Gap of Palgatcheri nearly to C. Comorin.

Elevation.—Elevation from 4,000 to 7,000 ft. A spacious table-land, 4,740 ft. A peaked summit, 6,000 ft. Another, 7,000 ft. Varragherry ms., 5,000 to 6,000 ft. Near C. Comorin, in the extreme S., 2,000 ft. Several not measured.

The W. brow is, with little exception, abrupt; on the E. side the declivity is gradual. Such a conformation would seem to indicate a volcanic disturbance along the W. precipitous face.

Eastern Ghauts, along Coromandel Coast.

Length, about 1,000 m. From Balasore, S.W. to Ganjam; thence to Naggery, near Madras; where it joins the range which crosses the country in a north-easterly direction, from the W. Ghauts, N. of the Gap of Palgatcheri.

Elevation.—Average elevation, about 1,500 ft. Cauvery Chain, 4,000 ft. Condapilly, 1,700 ft. W. of Madras, estimated 3,000 ft. Hill seen from the Moghalbuadi, between Pt. Palmyras and Chilka Lake, appearing in irregular scattered groups, 300 to 1,200 ft.

Granite constitutes the basis of the range; and clay, hornblende, flinty and primitive slate, or crystalline limestone, forms the sides of the mountains; and the level country, as far N. as the Pennar, appears to consist of the debris, when the laterite formation covers a large surface. From the Kistnah, northward, the granite is often penetrated by trap and greenstone. To Vizagapatam and Ganjam sienite and gneiss predominate, occasionally covered by laterite.

Assam Mountains, viz.:—

1. Naga Hills.

Length, about 250 m. On the S.E. border of Assam, stretches to the mountain range forming the N.W. boundary of Burmah. Centre, about 26° 30′, lon. 95°.

Elevation.—In the Khaibund range, supposed 4,000 ft. Some peaks are almost inaccessible.

The country is a wild unexplored tract. The measures adopted by the British Government to restrain the outrages committed by the Nagas within British territory, have led to their submission.

2. Duphala and Abor Hills.

Mountains N. of Assam, inhabited by Bhooteans, Duphala, and Abor tribes.

Elevation.—From 5,000 to 6,000 ft. above the surrounding level.

The face of Assam presents an immense plain, studded with clumps of hills, rising abruptly from the general level. The mountains on the N. are composed generally of primitive rocks. Those to the S., of tertiary and metamorphic.

3. Garrow Hills.

On the N.E. frontier of Bengal.

Elevation.—A confused assemblage, from 1,000 to 6,000 ft. Estimated area, 4,347 sq. m.

4. Cossyah Hills.

Estimated area, 7,290 sq. m. Between 25° and 26°, and 91° and 92°

Elevation.—Chirra Poonjee, 4,100 ft.

Character of country, wild. The rock formation is supposed to be chiefly of gneiss, or stratified granite.

Eighty m. in length from N. to S., and 40 in breadth. Extends from lat. 24° 55′ to 26° 7′, and from long. 91° 35′ to 92° 48′.

Elevation.—About 16 m. on the Silhet side, and about the same on that of Assam, consists of low land interspersed with small hills. In the interior, about 50 m. in extent, is an undulating hilly table-land, from 1,500 to 2,500 feet high.

Coal is said to abound in the hills of Jynteah.

Youmadoung, or Arracan Mountains.

Length, about 600 m. From Munneepoor, lat. 22° 20′ to C. Negrais, lat. 16°.

Elevation.—Average height, 3,000 to 5,000 ft. Blue Mountain, 22° 37′, 93° 11′, 8,000 ft. Pyramid Hill, 3,000 ft. Crest of Aeng Pass, 4,517 ft. Pass from Podangmew to Ramree, 4,000 ft. From Blue Mountain there is a gradual slope to C. Negrais, which is about 300 ft. high.

It is a continuation of the great mountain chain commencing at the S. of Assam, in 26° 30′; and extends S. running parallel with the river Irawaddy, and forms a natural barrier between Arracan and Ava.

Burmah Mountains.

Little known.

Elevation.—From Prome to Ava, characterized by unevenness and general elevation. Northerly, it is decidedly mountainous. Mountains 4 m. N. of Ava, 4,000 ft. Zyngait Mts., forming a kind of elevated dooab between the Saluen and Sittang rivers.

Gold, silver, iron, tin, lead, antimony, and other metals, are met with. Quarries of marble are worked near Ummerapoora. Coal has been discovered on the Irawaddy.

Tenasserim Mountains.

Length, about 500 m., breadth nowhere exceeds 80 m. Area, 30,000 sq. m.

Elevation.—Siamese Mts., running N. to S. along Tenasserim provinces, 3,000 to 5,000 ft. Mountains in Ye province, three parallel ridges, from 3,000 to 4,500 ft., gradually diminishing towards the coast, about 500 ft. Buffalo Mts., about 70 m., from Moulmein, 1,543 ft.

Coal of excellent quality has been discovered. Iron, tin, and gold are frequently met with. Country unexplored by Europeans.

Mountain Passes on the Indian Frontiers, from the Indus to the Irawaddy—as far as known.

Moola or Gundava—Cutch Gundava.	Lat. 28° 10′, lon. 66° 12′ ; lat. 28° 24′, lon. 67° 27′.—About 100 m. Open spaces, connected by defiles. Bapow, 5,250 ft. ; Peesee Bhent, 4,600 ; Nurd, 2,850 ; Bent-i-Jah, 1,850 ; Kullar, 750 ft. Descent, 4,650 ft., average 46 ft. per m. Water abundant. Practicable for artillery.*
Bolan—Beloochistan.	Lat. 29° 30′, lon. 67° 40′ ; lat. 29° 52′, lon. 67° 4′.—55 m. ; ½ m. wide at entrance. Entrance, 800 ft. ; Ab-i-goom, 2,540 ; crest, 5,793 ft. Average ascent, 90 ft. per m.† Practicable for artillery.
Gomul or Goolairee—Derejat.	Lat. 32°, lon. 70° 30′.—About 100 m. 20 m. from entrance road N.W., then 80 m. S.W., then N.W. to Ghuznee. Winding course.‡
Khyber—Peshawur.	Lat. 33° 58′, lon. 71° 30′.—About 33 m. Crest, 3,373 ft. Ali-Musjid, 2,433 ft. Rises gradually from the E., but has a steep declivity westward.§
Bamian—Afghanistan.	Lat. 34° 50′, lon. 67° 48′.—About 1 m. wide, bounded by nearly perpendicular steeps. Bamian, 8,496 ft., over a succession of ridges from 8,000 to 15,000. Only known route over Hindoo-Koosh for artillery or wheeled carriages.‖
Koushan—Hindoo-Koosh.	Lat. 35° 37′, lon. 68° 55′ : over principal shoulder of Hindoo-Koosh peak.—About 40 m. ; narrow. Crest, 15,000 ft. Road rocky and uneven descent, 200 ft. per m. Three entrances.¶
Khawak—Hindoo-Koosh.	Lat. 35° 38′, lon. 70°.—About 15 m. Crest, 13,200 ft. Ascent on N. side, an uniformly inclined plane.**
Bul Tul or Shur-ji-la—Cashmere.	Lat. 34° 10′, lon. 70° 15′. Crest, 10,500 ft.
Baramula—Cashmere.	Lat. 34° 10′, lon. 74° 30′. Only pass into Cashmere practicable for an army.
Bara Lacha—Tibet.	Lat. 32° 44′, lon. 77° 31′.
Rotang—Himalaya.	Lat. 32° 25′, lon. 77° 12′.
Manerung—Himalaya.	Lat. 31° 56′, lon. 78° 24′. Crest, 18,612 ; source of Darbung, 15,000 ft. Very difficult.
Charung—Himalaya.	Lat. 31° 24′, lon. 78° 35′. Crest, 17,348 ft. Extremely difficult.
Burenda—Himalaya.	Lat. 31° 23′, lon. 78° 12′.—Length of crest, 50 paces. Crest, 15,095 ft. Most elevated part a narrow glen, very steep.††
Bulcha—Kumaon.	Lat. 30° 28′, lon. 80° 14′. Over a high ridge extending E. and W.
Niti—Kumaon.	Lat. 30° 57′, lon. 79° 54. Crest, 16,814 ; village of Niti, 11,464 ft. Open from the end of June to October.‡‡

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* In 1839, the Anglo-Indian detachment marched through it. It is preferable to the Bolan Pass in a military point of view.

† A continuous succession of ravines and gorges. The air in the lower part of the pass is in summer oppressively hot and unhealthy.

‡ Of great commercial importance. Every spring, large caravans traverse it from Hindoostan to Afghanistan.

§ Called the Key of Afghanistan. At Ali-Musjid, merely the bed of a rivulet, with precipices rising on each side at an angle of 70°. Near Lamdee Khana, a gallery 12 ft. wide ; on one side a perpendicular wall, and on the other a deep precipice. It was twice forced by the British.

‖ The great commercial route from Kabool to Turkestan ; the several Passes to the eastward are less frequented on account of their difficulty and their elevation.

¶ Most frequented east of Bamian ; impassable for wheeled carriages.

** Scarcely frequented, yet may be considered the most practicable. Tamerlane crossed it on his march into Hindoostan.

†† Passes over the Outer Himalaya range :—Sugla, 31° 13′ lat., 78° 29′ lon.—elevation, 16,000 ft. ; Kimlia, 31° 15′, 78° 25′, 17,000 ; Siaga, 31° 16′, 78° 20′, 16,000 ; Marga, 31° 16′, 78° 21′, 16,000 ; Lumbia, 31° 16′, 78° 20′, 16,000 ; Barga, 31° 16′, 78° 19′, 15,000 ; Nulgun, 31° 19′, 78° 13′, 14,891 ; Rupin, 31° 2′, 78° 10′, 15,480 ; Ghusul, 31° 21′, 78° 8′, 15,851 ; Nibrung, 31° 22′, 78° 10′, 16,035 ; Gunas, 31° 21′, 78° 8′, 16,026 ; Yusu, 31° 24′, 78° 4′, 15,877 ; Sundru, 31° 24′, 78° 2′, 16,000 ; Shatul, 31° 25′ lat., 77° 58′ lon., 15,555 ft. In Koonawur there are 15 passes, at elevations varying from 15,000 to 17,000 ft.

‡‡ Considered the best pass between Kumaon and Tibet, and is one of the principal channels of trade between Chinese Tartary and Hindoostan.

Lat. 27° 38′, lon. 88°. Crest, 15,770 ft. Broad shelf of snow between rocky eminences.* — Kambachen—Nepaul.

Lat. 27° 33′, lon. 88° 1′. Crest, 16,000 ft. Temperature, 24° at 5 p.m. — Choonjerma—Nepaul.

Lat. 27° 52′, lon. 87° 14′. Crest, 16,755 ft. Path leading up the pass for eight miles, a narrow, stony, and steep gorge. Top, a low saddle, between two ridges of rock. — Wallanchoon—Nepaul.

Lat. 27° 38′, lon. 88° 56′. Crest, 16,100 ft. Ascent, on N.W. side, gradual, over a snow-bed and glacier; descent, on S.E., steep, but grassy. — Tunkra—Sikhim.

Lat. 27° 56′, lon. 88° 48′. Crest, 18,600 ft. View of Tibet from summit. — Donkia—Sikhim.

Lat. 19° 49′, lon. 94° 9′.—34 miles. Crest, 4,517; Khen-Kyomig, 3,777; Aeng, 147 ft. Average rise, 250 ft., average descent, 472 ft. per m.† — Aeng—Arracan.

Lat. 19° 14′, lon. 94° 30′. Myhee village, a police station. — Myhee—Arracan.

Rivers of British India.

Source, Course, Discharge, and Length.—Gangoutri, Himalaya, 1,400 ft. above the level of the sea. N.W. to Johnioi; W. and S.W., 13 m.; S.W., 36 m.; S., 15 m.; S.E., 39 m.; S., 8 m.; W., 24 m.; S.W., 15 m.; S., 130 m.; S.E. to Allahabad, E., 270 m.; E. to Sikrigalee; S.E. remainder of course into Bay of Bengal, by numerous mouths. The Ganges gives off some of its waters to form the Hooghly, and also anastomoses with the Megna.—Length, 1,514 m.

Tributaries, their Length, and Area drained.—Jumna, 860; Ghogra, 606; Gunduck, 450; Goomtee, 482; Sone, 465; Coosy, 325; Rumgunga, 373; Mahananda, 240; Karumnassa, 140; Koniae or Jumuna, 130; Aluknunda, 80; Bhillung, 50 m. —398,000 sq. m. drained, exclusive of Hooghly.

Navigable for river craft as far as Hurdwar, 1,100 m.; steamers ply as far as Gurmukteesur, 393 m. above Allahabad, distant from Calcutta *viâ* Delhi, 930 m.; at Cawnpoor, 140 m. above Allahabad, the navigation is plied with great activity. The breadth of the Ganges at Benares varies from 1,500 to 3,000 ft. Mean discharge of water there, throughout the year, 250,000 cub. ft. per second. — 1. Ganges.—Bhageeruttee at its source, and Podda near the sea.

Source, &c.—Formed by junction of Bhageeruttee and Tellinghee, two branches of Ganges. S. to Calcutta; S.W. to Diamond Harbour; E. and S.W. into the sea at Saugor roadstead, by an estuary 15 m. wide.—Length, 160 m., by winding of stream.

Tributaries, &c.—Dammoodah, 350; Dalkissore, 170; Coossy, 240; Mor. 130.—About 49,000 sq. m. drained.

Formerly navigable for a line-of-battle ship to Chandernagore; now, vessels drawing more than 17 ft., not safe in passing from Calcutta to the sea, by reason of shoals. — 2. Hooghly.

Source, &c.—Tibet, behind Kailas range, to the N. of Kailas peak, 22,000 ft. above the sea. N.W. to Dras R.; more northerly to Shy-yok; W.N.W., 115 m. to Makpon-i-Shagaron; S.S.W. and S. to Attock; a little W. of S. to confluence with Punjnud; S.W. to Khyrpoor; S. to Sehwan; S.E. to Hydrabad; W. of S. to Arabian Sea, Indian Ocean.—Length, 1,800 m.

Tributaries, &c.—Eekung-Choo, 110; Hanle, 70; Zanskar, 150; Dras, 75; Shyyok, 300; Shy-ghur, 70; Ghilgit; Cabool, 320; Sutlej, 850; Chenab, 765; Jhelum, 490; Ravee, 450; Punjnud, 60 m.—About 390,000 sq. m. drained.

Navigable to Attock, 942 m. from sea, there from 500 to 800 ft. wide; depth, 60 ft. Breadth and depth varies much after junction with Punjnud; breadth, 1 to 30 m.; depth, 12 to 186 feet. — 3. Indus, or Nilab ("Blue River.")

Source, &c.—N.E. extremity of Himalaya range; lat. 28° 30′, lon. 97° 20′. S.W., 63 m.; W., S.W., S.E., S.W., and E. to Bay of Bengal, through three mouths, Hattia, Ganges, and Shebazpoor.—Length, 933 m.

Tributaries, &c.—Sanpoo, 1,000; Dibong, 140; Noh-Dihong, 100; Boree Dehing, 150; Soobu-Sheeree, 180; Monas, 189; Bagnee, 150; Guddala, 160; Durlah, 148; — 4. Brahmapootra; Megna, near the sea.

* Ascended by Dr. Hooker, December 1848. The distance to which the voice was carried was very remarkable; he could hear distinctly every word spoken at from 300 to 400 yards off.

† Considerable trade carried on over this pass between Ava and Arracan.

Teesta, 313; Barak, 200; Goomtee, 140 m. In lat. 25° 10′, lon. 89° 43′, it gives off the Koniae.—305,000 sq. m. drained.

The branches of the Brahmapootra, together with those of the Ganges, intersect Lower Bengal in such a variety of directions as to form a complete system of inland navigation.

5. Irawaddy. *Source, &c.*—E. extremity of Himalaya, lat. 28° 5′, lon. 97° 58′. Nearly N. to S. through Burmah, and the recently acquired British territory of Pegu; into the Bay of Bengal by numerous mouths.—Length, 1,060 m.

Tributaries, &c.—Khyendwen, 470; Shwely, 180; Moo, 125 m.—164,000 sq. m. drained.

The Bassein branch affords a passage for the largest ships for 60 miles from its mouth. No river of similar magnitude, it is stated, presents so few obstructions to navigation.

6. Godavery. *Source, &c.*—E. declivity of W. Ghauts, near Nassik, 3,000 ft. above the sea. S.E., 200 m.; E. 100 m.; S.E., 85 m.; E., 170 m.; S.E., 200 m.; into Bay of Bengal, by three mouths.—Length, 898 m.

Tributaries, &c.—Wein-Gunga, 439; Manjera, 330; Poorna, 160; Paira, 105; Inderaotee, 140 m.—130,000 sq. m. drained.

In 1846, the sanction of the Court of Directors of E. I. C. was given to the construction, at an expense of 47,500*l.*, of a dam of sufficient height to command the delta, and to supply the rich alluvial soil of which that tract is composed, with the means of constant irrigation. The experiment of navigating the Godavery by steam has been entertained by the Madras government, and means for carrying it into effect are under consideration.

N.B.—Where no tributaries or area drained are mentioned, it is because, as regards the former, there are none of note; and the other is small, and imperfectly defined.

7. Kistnah, or Krishna. *Source, &c.*—Mahabulishwar table-land, Deccan, lat. 18° 1′, lon. 73° 41′; 4,500 ft. above the sea. S.E., 145 m.; N.E., 60 m.; S.E., 105 m.; N.E., 180 m.; S.E. to Chentapilly; S.E. 70 m. further; then, parting into two arms, one flowing S.E. 30 m., the other S. 25 m. into Bay of Bengal.—Length, 800 m.

Tributaries, &c.—Beemah, 510; Toongabudra, 325; Gutpurba, 160; Mulpurba, 160; Warna, 80; Dindee, 110; Peedda Wag, 70 m.—110,000 sq. m. drained.

The Kistnah, in consequence of the rapid declivity of its water-way and rockiness of its channel, cannot be navigated by small craft, even for short distances. An extensive system of irrigation in connection with this river is now in progress, and has been estimated to cost 150,000*l.*

WESTERN SIDE OF INDIA.

8. Nerbudda. *Source, &c.*—Amarkantak, a jungly table-land, lat. 22° 39′, lon. 81° 49′; from 3,500 to 5,000 feet above the sea. Nearly due W., with occasional bends, to Gulf of Cambay, by a wide estuary.—Length, 801 m.

Tributaries, &c.—Herrun; Samarsee, 60; Suktha, 70 m.—About 60,000 sq. m. drained.

The river, notwithstanding the great width of its bed in some parts of its upper course, appears to be scarcely anywhere continuously navigable for any considerable distance, in consequence of the innumerable basaltic rocks scattered over its channel.

9. Looner. *Source, &c.*—Arravulli Mts., near Pokur, lat. 26° 37′, lon. 74° 46′. S.W., nearly parallel with Arravulli range, into Runn of Cutch, by two mouths, principal in lat. 24° 42′, lon. 71° 11′.—Length, 320 m.

Tributaries, &c.—Rairee, 88; Sokree, 130 m.—About 19,000 sq. m. drained.

Bed full of micaceous quartoze rock; banks low, and little above the surrounding level.

10. Bunnas. *Source, &c.*—In a cluster of summits in the Arravulli range, lat. 24° 47′, lon. 73° 28′. S.W. into Runn of Cutch, by several small channels.—Length, 180 m.

About 17,000 sq. m. drained.

11. Bhader. *Source, &c.*—Kattywar, lat. 22° 10′, lon. 71° 18′. S.W., into Indian Ocean, near Poorbunder, lat. 21° 38′, lon. 69° 46′.—Length, 135 m.

12. Oojal. *Source, &c.*—Kattywar, lat. 21° 31′, lon. 70° 50′. Circuitous, but generally W., into backwater, behind Poorbunder.—Length, 75 m.

13. Ajee. *Source, &c.*—Kattywar, lat. 22° 10′, lon. 76° 31′. N.W. into Gulf of Cutch.—Length, 60 m.

14. Setroonjee. *Source, &c.*—Kattywar, lat. 21° 15′, lon. 70° 25′. E. into Gulf of Cambay.—Length, 60 m.

Source, &c.—Kattywar, lat. 22°, lon. 71° 20′. E. into Gulf of Cambay.—Length, 60 m. 15. Geyla.

Source, &c.—Kattywar, lat. 22° 18′, lon. 71° 30′. E. into Gulf of Cambay.—Length, 88 m. 16. Gooma.

Area of peninsula, 18,950 m.

The surface of Kattywar peninsula is generally undulating, with low ridges of hills, running in irregular directions. The land in the middlemost part is the highest, and here all the rivers take their rise, disemboguing themselves respectively into the Runn, the Gulf of Cutch, and the Gulf of Cambay.

Source, &c.—Sautpoora Mts., near Mooltae, lat. 21° 46′, lon. 78° 21′. Generally W., to Gulf of Cambay.—Length, 441 m. 17. Taptee.

Tributaries, &c.—Poorna, 160 ; Girna, 160 ; Boree, 90 ; Panjar, 92 m.—About 25,000 sq. m. drained.

It can scarcely be deemed a navigable stream, as at Surat, 17 m. from its mouth, it is fordable when the tide is out. It is said to be navigable in the dry season for boats of light draught, through Candeish. The mouth is obstructed by numerous sands and a bar.

Source, &c.—Vindhya Mts., lat. 22° 32′, lon. 75° 5′ ; 1,850 ft. above the sea. N.W., 145 m. ; W., 25 m. ; S.W., 180 m., into Gulf of Cambay.—Length, 350 m. 18. Mythe, or Make.

Tributaries, &c.—Amass, 90 ; Manchun, 55 m.

Navigable for 15 m. from its mouth. At 50 m. up 100 yds. wide ; bed, 400 yds.; depth, 1 ft.

Source, &c.—W. Ghauts, lat. 17° 50′, lon. 73° 36′. S.—W.—S.E.—W., into Indian Ocean.—Length, 55 m. 19. Washistee.

Source, &c.—W. Ghauts, lat. 18° 17′, lon. 73° 27′. S.E.—W., into Indian Ocean. —Length, 70 m. 20. Savitree.

Source, &c.—W. Ghauts, lat. 19° 41′, lon. 73° 29′. S.W.—W.—W.S.W.—W., into Indian Ocean.—Length, 58 m. 21. Taunsa.

Source, &c.—W. Ghauts, lat. 19° 54′, lon. 73° 24′. W.—S., into Indian Ocean.—Length, 68 m. 22. Soorla.

Source, &c.—W. Ghauts, lat. 20° 11′, lon. 73° 42′. W.—N.—W.N.W., into Indian Ocean.—Length, 58 m. 23. Damgunga.

Source, &c.—W. Ghauts, lat. 20° 30′, lon. 73° 43′. W., into Indian Ocean.—Length, 50 m. 24. Par.

Tributaries, &c.—No tributaries of note ; area drained small, and imperfectly defined.

Though rugged, the Concans have many fertile valleys, each of which, for the most part, affords a passage for a small river or torrent, holding a westerly course from the Ghauts to Indian Ocean. The most fertile spots are on the banks of streams. The rivers abound with fish, but are also frequented by alligators. The Savitree is navigable as far as Mhar, 30 m. from its mouth.

WESTERN INDIA.

Source, &c.—W. Ghauts, lat. 20° 50′, lon. 73° 42′. W., into Indian Ocean.—Length, 70 m. 25. Eeb.

Source, &c.—W. Ghauts, lat. 20° 59′, lon. 73° 44′. W., into the Indian Ocean.—Length, 60 m. 26. Poorna.

Source, &c.—Plain of Dharwar, lat. 15° 45′, lon. 75° 10′. S.—S.W., into Indian Ocean.—Length, 100 m. 27. Gungavully.

Tributaries, &c.—No tributaries of any extent ; and area drained imperfectly known.

Source, &c.—Plain of Dharwar, lat. 15° 33′, lon. 74° 47′. S., 61 m. ; W., 30 m., into Indian Ocean.—Length, 91 m. 28. Cauly Nuddee.

Navigated by the largest patimars for 20 m. From Mullapoor to Shedashegur, rendered easy by uniformity of channel.

Source, &c.—Coimbatoor, lat. 10° 19′, lon. 77° 6′. N.W.—W., into Indian Ocean, —Length, 128 m. 29. Ponany.

Navigable for canoes as far as Palghat, 63 m. from the sea.

EASTERN SIDE OF INDIA.

Source, &c.—Madura, lat. 10° 17′, lon. 77° 37′. S.E., into Bay of Bengal.—Length, 130 m.

30. Vygah. The large anicuts upon it are Conoor, diverting a stream of same name, Parea Anai, and Chittanaik.

31. Vellaur. *Source, &c.*—Base of E. Ghauts, lat. 10° 28′, lon. 78° 21′. E., into Gulf of Manaar.—Length, 80 m.

32. Goondah. *Source, &c.*—Vellanuddhee hills, Madura. S.E., into Gulf of Manaar. Length, 95 m.

33. Cauvery. *Source, &c.*—Coorg, lat. 12° 25′, lon. 75° 34′. E., 33 m.; N.E., 28 m.; S.E., 95 m.; N.E.—E.—S.E., 47 m.; S., 47 m.; S.E.—E.—N.E., into Bay of Bengal.—Length, 472 m.

Tributaries, &c.—Magunmurchy, 40; Bhovani, 120; Noyel, 95 m.; Hennavutty; Leechman-Teert; Cubbany; Shimska; Arkavati; Ambrawutty.—About 36,000 sq. m. drained.

Navigable for craft through the low country during the inundation. Gungnan Zooka fall, 370 ft. Burr Zooka, 460 ft.

34. Vellaur. *Source, &c.*—Base of E. Ghauts. E., into Bay of Bengal, near Porto Novo.

The river is small at its mouth, and admits only coasting craft.

35. Palar. *Source, &c.*—Mysoor table-land, lat. 13° 20′, lon. 78° 2′. S.E., 55 m.; E., 87 m.; S.E., 48 m., into Bay of Bengal.—Length, about 220 m.

Tributaries, &c.—Pony, 40; Sheyaroo, 90 m.

The entrance of the Palar, near Sadras, is contracted by a bar or narrow ridge of sand, inside of which the river becomes of considerable width.

36. Soornamooky. *Source, &c.*—Mysoor table-land, lat. 13° 26′, lon. 79° 11′. N.E., to Bay of Bengal.—Length, 99 m.

37. Pennar, N. *Source, &c.*—Nundidroog table-land, lat. 13° 23′, lon. 77° 43′. N.W., 30 m.; N., 95 m.; E., 230 m., into Bay of Bengal.—Length, 355 m.

Tributaries, &c.—Chittravutti, 107; Paupugnee, 130; Chittair, 75 m.

38. Pennar, S. *Source, &c.*—N. Nundidroog table-land, lat. 13° 32′, lon. 77° 45′. S. to Mootanhalli, 55 m.; S.E., 190 m., into Bay of Bengal, a mile N. of Ft. St. David.—Length, 245 m.

Gold is found in its sands, in its passage through the Carnatic.

39. Gundlacama. *Source, &c.*—Lat. 15° 40′, lon. 78° 49′. Very circuitous; E.—N.E.—S.S.E.—S.E., into Bay of Nizampatnam.—Length, 155 m.

40. Bondsdora. *Source, &c.*—Table-land of Orissa, lat. 19° 39′, lon. 83° 27′. S., into Bay of Bengal.—Length, 130 m.

41. Lalglah. *Source, &c.*—Table-land of Orissa, near source of Bondsdora. S., into Bay of Bengal.—Length, 133 m.

42. Mahanuddy. *Source, &c.*—Native state or Nowagudda, lat. 20° 20′, lon. 82°. W., 30 m.; N.E., 110 m.; S.E., 300 m., to Bay of Bengal by numerous mouths.—Length, 520 m.

Tributaries, &c.—Hutsoo, 130; Aurag, 117; Tell, 130; Bang Nuddee, 60 m.—About 46,000 sq. m. drained.

From July to February, navigable for boats for 460 m.

43. Brahminy. *Source, &c.*—Palamow table-land, lat. 23° 25′, lon. 84° 13′. S.—E.—S.E., into Bay of Bongal, near Pt. Palmyras.—Length, 410 m.

44. Byturnee. *Source, &c.*—Near Lohardugga, lat. 23° 29′, lon. 84° 55′. N.—E.—S.—S.W.—S.E.—E., into Bay of Bengal, by Dhumrah river.—Length, 345 m.

Tributaries, &c.—Sunk, 95 m.—About 26,000 sq. m., are drained by Brahminy and Byturnee.

Sacred in the Hindoo mythology, more especially at its source.

45. Soobunreeka (En. India). *Source, &c.*—Chota Nagpoor table-land. N.E.—E.—S.E.—S.—S.E.—E.—S.E.—S., into Bay of Bengal.—Length, 280 m.

Tributaries, &c.—Karow, 80 m. About 12,000 sq. m. drained.

EAST SIDE, BENGAL BAY.

Tributaries, &c.—Near Blue Mountain, Youmadoung range, lat. 22° 27′, lon. 92° 51′. S., into Combermere Bay.—Length, 160 m.

46. Arracan, or Coladyne. *Source, &c.*—Myoo; Lemyo.

Navigable within a few miles of Arracan town, for ships of 250 tons burden

90 m. above Akyab, the stream is narrow, and navigable only for canoes. 10 m. broad at its mouth.

Source, &c.—Burmah, lat. 21° 40′, lon. 96° 50′. S., into Gulf of Martaban.— Length, 420 m. 47. Sittang.

Tributaries, &c.—Yennan, 115; Saar, 120 m.

It is a navigable river. For about 190 m. forms the boundary between the Tenasserim provinces and Pegu.

Source, &c.—N. of Yunnan province, China; about lat. 27° 10′, long. 98° 57′. S., into Gulf of Martaban, by two mouths, formed by Pelewgewen Island.—Length, 430 m. 48. Saluen, or Salween.

Tributaries, &c.—Attaran of Weingo, 110; Thoung-yin Myit, 225; Meloun, 90 m.

It enters the British dominions about lat. 18° 40′.

Source, &c.—Supposed to lie in the mountains to the N.E. of Tavoy, between the 14th and 15th parallel of latitude. S. to Metamio, lat. 14° 13′; S.E. and S. to Tenasserim town; N.W. into Bay of Bengal, by two mouths.—Length, 270 m. 49. Tenasserim.

Tributaries, &c.—Baing-Khiaung; Little Tenasserim; Kamaun Khiaung.

Upper part of course through a wild and uncultivated tract, sometimes between high and perpendicular banks. It afterwards opens on extensive plains. On many parts of its banks exist forests of fine teak, and the valuable sappan wood.

TRIBUTARIES.

Source, &c.—Jumnoutri, Himalaya, lat 31°, lon. 78° 32′; 10,849 ft. above the sea, S.W.—S.E., to Ganges, at Allahabad.—Length, 860 m. Jumna, tributary to Ganges.

Tributaries, &c.—Tonse or Supin, about 100; Hindan, about 160; Hansoutee, 99; Bangunga, 220; Chumbul, 570; Sinde, 260; Betwa, 360; Cane, 230; Baghin Nuddee, 90; Seyngur, 210; Urrund Nuddee, 245 m. About 105,000 sq. m. drained.

In consequence of its bed been obstructed by shoals and rocks, navigation is not practicable for craft above Delhi, except by means of the canal. Its banks are lofty and precipitous, and ridges of rock in many places advance into the stream, combining with its general shallowness and strong current to render navigation extremely difficult and dangerous.

Source, &c.—N. of Kumoan, lat. 30° 28′, lon. 80° 40′, probably between 17,000 and 18,000 ft. S.E., 33 m.; S.W., 70 m.; S.E., 12 m.; S., 30 m.; S., 23 m. further; S.E., to Ganges, near Chupra.—Length, 606 m. Ghogra, tributary to Ganges.

Tributaries, &c.—Raptee, 134; Kurnalli, 225; Bhyrvee, 70; Dhauli, 45; Goringunga, 60 m.—About 49,000 sq. m. drained.

Butter describes it as navigable for the largest class of boats in all seasons.

Source, &c.—In a small lake or morass, 19 m. E. of the town of Pillebheet. Lat. 28° 35′, lon. 80° 10′; 520 feet above the sea. S.—S.E., into Ganges, 30 m. below Benares.—Length, 482 m. Goomtee, tributary to Ganges.

In the rainy season, boats of 1,000 or 1,200 maunds (40 tons) burthen, are sometimes seen proceeding to Lucknow.

Source, &c.—Amarkantak table-land, lat. 22° 41′, lon. 82° 7′; from 3,500 to 5,000 ft. above the sea. N., 30 m.; N.W., 80 m.; N., 40 m.; N.E., 125 m.; E., 47 m.; N.E., into the Ganges, 10 m. above Dinapoor.—Length, 465 m. Sone, tributary to Ganges.

Tributaries, &c.—Koel, 140; Kunher, 130; Johila, 100 m.—Including the Phalgu and other rivers falling into the Ganges above Rajmahal, about 42,000 sq. m. drained.

The navigation of the river is not considered available for purposes of important utility higher than Daudnagur, 60 m. from the confluence with the Ganges.

Source, &c.—Near Dhawalagiri peak, Himalaya. S.—S.E.—S.W.—S.E., into Ganges, near Patna.—Length, 407 m. Gunduck, tributary to Ganges.

Tributaries, &c.—Trisula-gunga, 100; Marachangdi, 100; Naling, 110 m.—About 40,000 sq. m. drained.

Though navigable continuously through its whole course downwards from Bhelaunji, there are in the part of its channel nearer that place many rapids and passes, where, the course being obstructed by rocks, navigation becomes difficult and dangerous.

Source, &c.—Malwa, lat. 22° 26′, lon. 75° 45′, 8 or 9 m. S.W. from Mhow, which is 2,019 ft. above the sea. It rises in the cluster called Janapava. N., 105 m.; N.W., 6 m.; S.E., 10 m.; N.E., 23 m.; N.W., 25 m.; N. to junction with Kallee Sind; Chumbul, tributary to Jumna.

N.E., 145 m.; S.E., 78 m., to Jumna.—Length, 570 m., described in a form nearly semicircular, the diameter being only 330 m.

Tributaries, &c.—Chumbela, 70 ; Seepra, 120 ; Parbutty, 220 ; Kallee Sind, 225 ; Banas, 320 ; Chota Kallee Sind, 104 m.—About 56,000 sq. m. drained.

It does not appear to be used for navigation, which is probably incompatible with the average declivity of its bed (2 ft. 5 in. per m.), and still more so with the general rugged and rocky character of its channel. Its average volume of water is so considerable, that on its junction it has been known to raise the united stream 7 or 8 feet in 12 hours.

Ramgunga, tributary to Ganges.

Source, &c.—Kumaon, lat. 30° 6′, lon. 79° 20′; about 7,144 ft. above the sea. S.E., 20 m.; S.W., 70 m.; S. to Moradabad—S.E.—S., into Ganges.—Length, 373 m.

Tributaries, &c.—Kosee, 150 ; Gurra, 240 m.

Fordable at Moradabad, at 15 m. below confluence with Kosee ; but not usually fordable below Jellalabad.

Coosy, tributary to Ganges.

Source, &c.—Himalaya Mountains, lat. 28° 25′, lon. 86° 11′. S.W.—S.E.—S.—E.—S.E.—S. into Ganges.—Length, 325 m.

Tributaries, &c.—Arun, 310; Tambur, 95; Gogaree, 235; Dud Coosy, 50; Tiljuga. 40 m.—46,000 sq. m. drained.

Where narrowest, and when lowest, stream, 1,200 ft. wide and 15 ft. deep. It is larger than the Jumna or the Ghogra.

Mahananda, tributary to Ganges.

Source, &c.—Near Darjeeling, in the Sikhim hills, lat. 26° 57′, lon. 88° 20′. S., 40 m.; S.W., 60 m. ; S.E., 50 m.; S., 20 m.; S.E., 40 m.; S., 30 m.—Length 240 m.

Navigable during the dry season for craft of 8 tons as far as Kishengunge, for those of much larger burthen during the rains.

Karumnassa, tributary to Ganges.

Source, &c.—In the Kymore range, lat. 24° 38′, lon. 83° 11′. N.—N.W., into the Ganges, near Ghazeepoor.—Length, 140 m.

Tons, tributary to Ganges.

Source, &c.—Lat. 24°, lon. 80° 30′. N.W.—E.N.E.—N., into the Ganges, a few miles below Allahabad.—Length, 165 m.

Tributaries, &c.—Satni, Beher, Mahana, Belun, and Seoti.—Including small streams, 13,000 sq. m. drained.

Aluknunda, tributary to Ganges.

Source, &c.—Lat. 30° 33′, lon. 79° 38′. N.W.—S.W.—W.—S.W., into the Bhageerutte, at Deoprayag.—Length, 80 m.

Tributaries, &c.—Doulee, 35 ; Vishnuganga, 25; Mundakni, 32 ; Pindur, 60 m.

At confluence with Bhageeruttee, 142 ft. broad ; rises 46 ft. during the melting of the snow.

Bhillung, tributary to Ganges.

Source, &c.—Lat. 30° 46′, lon. 78° 55′. S.W., into the Bhageeruttee.—Length, 50 m.

Between 60 and 70 ft. wide in the beginning of May, 5 m. from its mouth.

Dammoodah, tributary to Hooghly.

Source, &c.—Ramghur district, lat. 23° 55′, lon. 84° 53′. E. and S.E., to Burdwan ; S., to Diamond Harbour.—Length, 350 m.

Tributaries, &c.—Barrachur, 155 m.

Crossed by a ferry 50 m. above its mouth. At Raneegunj, 135 m. from mouth, 500 yds. wide, fordable, with a rapid current about 1 ft. deep in December.

Coossy, tributary to Hooghly.

Source, &c.—Ramghur district, lat. 23° 35′, long. 85° 58′. Circuitous, but generally S.E., into Hooghly.—Length, 240 m.

Tributaries, &c.—Comaree.

It is crossed at Ameenugur, 80 m. from source, and at Koilaghat, 41 m. from mouth, by fords during the dry season, and ferries during the rains.

Dalkissore, tributary to Hooghly.

Source, &c.—Pachete district, lat. 23° 30′, lon. 86° 34′. S.E.—S.—S.E., into Hooghly at Diamond Harbour.—Length, 170 m.

Crossed at Bancoora, 50 m. from source, and at Jahanabad, by means of fords.

Shy-yok, tributary to Indus.

Source, &c.—Near Kara-korum Pass. S.E.—N.W., into Indus, near Iskardo.—Length, 300 m.

Tributaries, &c.—Chang-Chenmo, 58 ; Nubra, 66 m.

Cabool, tributary to Indus.

Source, &c.—Lat. 34° 15′, lon. 68° 10′, near Sir-i-Chusma, in Affghanistan ; elevation, 8,400 ft. Generally E., through the valley of Cabool, and plains of Jellalabad and Peshawur, into the Indus.—Length, about 320 m.

Tributaries, &c.—Punchshir, 120 ; Tagao, 80 ; Alishang, 120 ; Soorkh-Rood, 70 ; Kooner, 230; Suwat, 150 m.—About 42,000 sq. m. drained.

Not navigable along the N. base of Khyber Mts. except on rafts and hides. Navigable for boats of 40 or 50 tons to Dobundee.

Source, &c.—N. declivity of Barra-Lacha Pass, lat. 32° 47′, lon. 77° 33′. N.W.—W.—N.W.—N.E.—N.W.—N.E., into the Indus, a few miles below Le.—Length, 150 m. Zanskar, tributary to Indus.

Tributaries, &c.—Trarap, 42 ; Zingchan-Tokpo, 22 m.

Source, &c.—Remote sources, Lakes Manasarowar and Rahwan Hrad, lat. 30° 8′, lon. 81° 53′; 15,200 ft. above the sea. N.W., 180 m.; S.W. through Bussahir; W. to junction with Beas; S.W. to Punjnud.—Length, 550 m. to junction with Beas; 300 m. farther to Punjnud ; total, 850 m. Sutlej, tributary to Indus.

Tributaries, &c.—Spiti, 120; Buspa, 52 ; Beas, 290 m.—About 29,000 sq. m., or, including Ghara and Beas, about 65,000 sq. m. drained.

At Roopur, 30 ft. deep, and more than 500 yds. wide. Navigable as far as Filoor in all seasons, for vessels of 10 or 12 tons burthen.

Source, &c.—On S. verge of Rotang Pass, lat. 32° 24′, lon. 77° 11′; 13,200 ft. above the sea. S., 80 m.; W., 50 m.; then a wide sweep to N.W. for 80 m.; S., 80 m., to Sutlej, at Endreesa.—Length, 290 m. Beas, tributary to Sutlej.

Tributaries, &c.—Parbati ; Sainj, 38 ; Gomati, 55 m. ; Ul ; Gaj.—About 10,000 sq. m. drained.

Source, &c.—Near Bara-Lacha Pass, lat. 32° 48′, lon. 77° 27′. N.W. to Murumurdwun ; S.W. to confluence with Jhelum, thence S.W. to Ghara, or continuation of Sutlej.—Length, 605 m. to Jhelum, 765 m. to Ghara. Chenab, tributary to Indus.

Tributaries, &c.—Suruj-Bhagur, 44 ; Murumurdwun, 86 ; Dharh, 56 m.—About 21,000 ; including Jhelum, 50,000 ; and with Ravee, 72,000 sq. m. drained.

Becomes navigable for timber rafts at Aknur. Descends at the average rate of 40 ft. per m. for the first 200 m. Estimated elevation at Kishtewar, 5,000 ft.

Source, &c.—The Lidur, in N.E. mountains of Cashmere, near Shesha Nag. Through valley of Cashmere, and into Punjab by Baramula gorge; S. to Chenab confluence, in lat. 30° 10′, lon. 79° 9′. Length, 409 m. Jhelum, tributary to Chenab.

Tributaries, &c.—Lidur, 50 ; Vishnau, 44; Sindh, 72 ; Lolab, 44 ; Kishengunga, 140 ; Kunihar, 100 ; Pirpanjal, 115 m.—About 280,000 sq. m. drained.

Navigable for 70 m. through Cashmere. Navigable from the Indus to the town of Ohind.

Source, &c.—Lat. 32° 26′, lon. 77°, in the Pirpanjal, or Mid-Himalaya range, to the W. of Rotang Pass. S.W., about 40 m. ; W. to Lahore ; S.W. to junction with Chenab.—Length, 450 m. Ravee, tributary to Chenab.

Tributaries, &c.—Nye, 20 ; Sana, 36 ; Chakki, 50 m.—About 22,000 sq. m. drained.

Tortuous course ; fordable in most places for eight months of the year.

Source, &c.—N. face of Himalayas, lat. 30° 25′, lon. 82° 5′. E., winding its way through Tibet, and washing the borders of the territory of Lassa. It then turns suddenly S., and falls into the Brahmapootra, under the name of Dihong.—Length, about 1,000 m. Sanpoo, tributary to Brahmapootra.

Tributaries, &c.—Sanki-Sanpoo, Niamtsion, Zzangtsiou, Lalee Nuddee.

Source, &c.—About lat. 27° 59′, lon. 88° 50′. S.—S.E., into Brahmapootra.—Length, 333 m. Teesta, tributary to Brahmapootra.

Tributaries, &c.—Lachoong, 23 ; Rungbo, 22 ; Rungeet, 23 m.

Navigable for craft of 6 or 7 tons as far up as Puharpoor, 15 m. beyond the divergence of the Attree.

Source, &c.—It is an offset from the Jeree, which leaves in lat. 24° 43′, lon. 93° 13′. W. through Cachar and Silhet ; S.W., into Megna.—Length, 200 m. Barak, tributary to Brahmapootra.

Banks low and marshy along the valley of the Cachar.

Source, &c.—Himalaya range, lat. 28° 20′, lon. 91° 18′. S., 40 m. ; S.W., 110 m.; S.W., into Brahmapootra.—Length, 189 m. Monas, tributary to Brahmapootra.

Tributaries, &c.—Deemree, of greater length than itself.

Source, &c.—Burmah, lat. 26° 28′, lon. 96° 54′. Generally S., into Irawaddy, near the town of Amyenmyo.—Length, 470 m. Khyendwen, tributary to Irawaddy.

Tributaries, &c.—Myitia Khyoung, 170 m.

Wein-Gunga, or Prenheta, tributary to Godavery.

Source, &c.—Mahadeo Mountains, lat. 22° 25, lon. 79° 8′. E., 80 m.; S., 34 m.; S., 25 m.; S.W., 80 m.; S., 100 m.; into Godavery.—Length, 439 m.

Tributaries, &c.—Pench Nuddee, 150; Kanhan Nuddee, 130 m.—About 21,000 sq. m. drained, exclusive of Payne-Gunga and Wurda.

Elevation at Bundara, lat. 21° 12′; 872 ft. above the sea.

Wurda, tributary to Wein-Gunga.

Source, &c.—Sautpoora Mountains, lat. 21° 44′, lon. 78° 25′. Generally N.W. to S.E.—Length, about 250 m.

Tributaries, &c.—Payne-Gunga, 320 m.—About 8,000 sq. m. drained.

Fordable, except at the height of the rains; then navigable for 100 m. above its mouth.

Payne-Gunga, tributary to Wein-Gunga.

Source, &c.—Lat. 20° 32′, lon. 76° 4′, in Candeish. Very circuitous, but generally E., into Wurda.—Length, 320 m.

Tributaries, &c.—Araun, 105; Koony, 65 m.—About 8,000 sq. m. drained.

Manjera, tributary to Godavery.

Source, &c.—Lat. 18° 44′, lon. 75° 30′. S.E., S.W., into Godavery.—Length 330 m.

Tributaries, &c.—Thairnya, 95; Narinja, 75; Munnada, 100 m.—About 11,000 sq. m. drained.

Beemah, tributary to Kistnah.

Source, &c.—Lat. 19° 5′, lon. 73° 33′, in the table-land of the district of Poona; 3,090 ft. above the sea. S.E. into Kistnah.—Length, 510 m.

Tributaries, &c.—Goor, 100; Neera, 120; Seena, 170; Tandoor, 85 m.—About 29,000 sq. m. drained.

Toongabudra, tributary to Kistnah.

Source, &c.—Lat. 14°, lon. 75° 43′, junction of Toonga and Budra rivers. N.—N.E., into Kistnah.—Length, 325 m.

Tributaries, &c.—Chinna Hugry; Hundry, 225 m.; Wurda.—About 28,000 sq. m. drained.

Rocky obstacles to navigation in upper part of course. Fine teak forests on banks.

Poornah, tributary to Taptee.

Source, &c.—Lat. 21° 35′, lon. 77° 41′. S., 65 m.; W., 25 m.; into the Taptee.—Length, 160 m.

Girna, tributary to Taptee.

Source, &c.—E. slope of W. Ghauts, lat. 20° 37′, lon. 73° 25′. E., 120 m.; N., 50 m.; into the Taptee.—Length, 160 m.

Bhovani, tributary to Cauvery.

Source, &c.—Among the Kundah group, lat. 11° 15′, lon. 76° 4′. E. into Cauvery.—Length, 120 m.

Noyel, tributary to Cauvery.

Source, &c.—E. slope of W. Ghauts, lat. 10° 59′, lon. 76° 44. E., into Cauvery.—Length, 95 m.

Hutsoo, tributary to Mahanuddy.

Source, &c.—Lat. 23° 18′, lon. 82° 32′. S., into Mahanuddy.—Length, 130 m.

Tell, tributary to Mahanuddy.

Source, &c.—Lat. 19° 54′, lon. 82′ 41′. N.W., into Mahanuddy. Length, 130 m.

NOTE.—*Of the above-named rivers,* 49 *main streams flow to the sea; the chief tributaries to these number* 210; *of which* 30 *flow for* 200 *m. and upwards;* 63 *have a course of* 100 *to* 200 *m.; and the remainder under* 100 *m.*

RIVERS IN AFGHANISTAN.

Helmund.

Source, &c.—Pughman range, lat. 34° 40′, lon. 68° 2′; at an elevation of 10,076 ft. above the sea. Westerly; south-westerly to Pullaluk; north-westerly; in the Hamoon marshy lake, and that of Duk-i-Teer, by numerous channels.—650 miles.

Tributaries, &c.—At 25 m. below Girishk receives the Urgundab, 250 m.; Turnak.

At Girishk, 350 m. from source; banks about 1,000 yards apart; in spring spreads beyond these limits; depth, 10 or 12 ft., with a rapid current. At Pullaluk it was crossed by Christie, who found it, at the end of March, 400 yards wide, and very deep.

Lorah.

Source, &c.—Shawl table-land, lat. 39° 49′, lon. 67° 20′. South-westerly, until lost in the sands of the desert of Khorasan.—About 80 miles.

In April the water (which is briny) is 7 or 8 yards wide, and 2 ft. deep. It is crossed on the route from Shawl to Kandahar.

Source, &c.—Valley of Bamian, about lat. 34° 52′, lon. 67° 40′. Easterly; northerly; north-easterly; northerly; and north-westerly; into the Amoo or Jinoon River.—About 300 miles. Koondooz.

Tributaries, &c.—Inderaub, 65; and Khanah-i-bad, 90 m.

Source, &c.—Huzareh Mountains, lat. 34° 50′, lon. 66° 20′; 9,500 ft. above the sea. Generally westerly to Herat, where it turns north-westerly, forming a junction with the Moorghaub; the united stream is ultimately lost in the desert of Khorasan.—About 600 miles. Heri Rood, or Hury.

Tributary, &c.—Sir-i-Jungle, 90 m.

At Herat, it was formerly crossed by a brick bridge, but three out of thirty-three arches being swept away, communication is intercepted in time of inundation. It is remarkable for the purity of its water.

Source, &c.—Jhalawan province, about lat. 27° 23′, lon. 66° 21′. Southerly, through Lus province into the Indian Ocean, in lat. 25° 23′, lon. 66° 20′; near Sonmeanee.—100 miles.* Poorallee.

From the bund N. of Lyaree, the river has no bed; as it fills, during the rains, the bund is swept away, and the water inundates the plain, which is here about 5 m. broad.

Source, &c.—Huzareh Mountains, about lat. 33° 50′, lon. 68° 20′. Generally southerly, as far as lat. 33°; afterwards south-westerly; into Lake Abistada, in lat. 32° 42′, lon. 68° 3′.—About 60 miles.* Ghuznee.

Source, &c.—Sir-i-Bolan, Bolan Pass, lat. 29° 51′, lon. 67° 8′; 4,494 ft. above sea. Remarkably sinuous, but generally south-easterly; from a junction with the Nari River.—About 70 miles.* Bolan.

Liable to inundations; and as its bed, in some parts, occupies the whole breadth of the ravine, travellers are frequently overtaken by the torrent. Falls 3,751 ft. in 50 m., from source to Dadur.

Source, &c.—A few miles S. of Kelat, in Beloochistan. South-easterly, about 80 miles; north-easterly; and easterly; ultimately absorbed in the desert of Shikarpoor.—About 150 miles.* Moola.

The Moola or Gundava Pass winds along its course.

Source, &c.—Huzareh Mountains, about lat. 33°, lon. 67°. South-westerly to 25 m. past Kandahar; westerly remainder of course,—falls into the Helmund River.—250 miles. Urgundab.

Tributary.—Turnak.

Where crossed 12 m. from Kandahar, it is, ordinarily, about 40 yards wide, from 2 to 3 ft. deep, and fordable; but in inundations, becomes much increased. Greater part of its water drawn off to fertilize the country.

Source, &c.—Afghanistan, about lat. 33°, lon. 69° 6′, at the foot of an offshoot from Sufied-Koh. S.; W.; and a little E. of S. to Goolkuts; thence E., N.E., and S.E., until absorbed by the sands of the Daman.—About 160 miles. Gomul.

Tributary.—Zhobe, about 170 m.

Its bed for a great distance forms the Goolairee Pass, or great middle route from Hindoostan to Khorasan, by Dera Ismael Khan and Ghuznee: crosses the Suliman range, lat. 32°.

Table-Lands of British India.

Extends by the Arravulli, Dongurpoor, Vindhya, Bindyachal, Panna, and Bandair ranges,—73° to 84°; about 700 m. long; breadth very various,—greatest from Amjherra to Ajmeer, 250 m.; from Mhow to Mokundurra, 150 m.; at Saugor and Dumoh, 75 m.; afterwards very narrow. Central India, including Oodeypoor, Malwa, Bhopal, Bundelcund, and Shahabad.

Highest towards S. and W.; average of Oodeypoor, 2,000 ft. Malwa, 1,500 to 2,000 ft. Bhopal, 2,000 ft. Bundelcund, about 1,000 ft. Shahabad, 700 ft. Plain of Ajmere, 2,000 ft. Oodeypoor town, 24° 37′, 73° 49′; 2,064 ft.—slope to N.E., Banas River flowing in that direction; gradual fall also to valley of Chumbul River, where it rises to Malwa; Mhow, 2,019 ft. Dectaun, 1,881 ft. Dhar, 1,908 ft. Indore, 1,998 ft. Crest of Jaum-Ghaut, 2,328 ft. Oojein, 1,698 ft. Adjygurh,

* The tributaries of these rivers, in the countries adjacent to India, are as yet very imperfectly known,—as indeed are also the origin and courses of the rivers themselves, or the countries through which they flow.

1,340 ft. Amjherra, 1,890 ft. Saugor, 1,940 ft. Rhotasgurh, 700 ft. Sonar River, source, 1,900 ft. From the Vindhya range the surface has a generally gradual, but in some places abrupt, descent; as at Mokundurra, and the Bindyachal hills, where rivers occasionally fall over the brow in cascades. Shahabad district very rocky and uneven.

Tin and copper are found in Oodeypoor. In Bhopal the prevailing geological formation appears to be trap overlying sandstone. Minerals are few and unimportant. Water is very plentiful. The mineral resources of Bundelcund appear to be considerable.

Southern India, including Deccan, Mysoor, &c.

Supported as it were by a triangle formed by the Sautpoora or sub-Vindhya on the N., W. Ghauts on the W., and E. Ghauts on the E.; the Sautpoora range constituting the base. Length, from Sautpoora River to Salem, about 700 m.; breadth from Mahabulishwar to Sirgoojah, about 700 m. If Choota-Nagpoor be considered as part of this great table-land, it may be said to extend nearly 250 m. farther in a north-easterly direction.

Highest parts, those nearest W. Ghauts, and in centre of Mysoor. Mahabulishwar, 18°, 73° 45′; 4,700 ft. Source of Kistnah, 4,500 ft. Source of Godavery, 3,000 ft. Poona 2,823 ft. Source of Manjera, 3,019 ft. Rivers rising in ravines between spurs of W. Ghauts, wind their way through E. Ghauts across the Deccan, the slope being in that direction. Plains of Nagpoor, 1,000 ft.—slope to S.E.; drained by Wein-Gunga, which falls into Godavery. Hydrabad, 1,800 ft. Secunderabad, 17° 26′, 78° 33′; 1,837 ft. Beder 17° 53′, 77° 36′; 2,359 ft. From the Wein-Gunga the surface rises towards N.E., where Rypoor, 21° 12′, 81° 40′, is 1,747 ft. Source of Mahanuddy, 2,111 ft.; and Konkeir, 20° 16′, 81° 33′, 1,953 ft. Nundy-droog, highest in Mysoor, 4,856 ft.; slope from hence on all sides,—S. to Bangalore, 3,000 ft.; E. to plains of Carnatic—Chittoor, 1,100 ft.; N. to plains of Gooty, 1,182 ft.; and those of Bellary, 1,600 ft. Colar, 13° 8′, 78° 10′; 2,800 ft. Mysoor town, 12° 18′, 76° 42′; 2,450 ft. Seringapatam, 12° 25′, 76° 45′, 2,412,—from hence, there is a gradual rise to Coorg, where Verajenderpetta is 3,399 ft., and Merkara, 4,506 ft. From Bangalore, descent to S. by rather abrupt steps to plains of Salem, 1,400 ft., and Coimbatoor, 1,483 ft. From Belgaum, 15° 50′, 74° 36′, 2,500 ft. there is a gradual fall to the E. Bellary plains, 1,600 ft. Gooty plains, 1,182 ft.; Cuddapah town, 507 ft.; and E. part of Cuddapah district, 450 ft.

Hypogene schists, penetrated and broken up by prodigious outbursts of plutonic and trappean rocks, occupy by far the greater portion of the superficies of Southern India. The central part of the Deccan is composed of waving downs, which, at one time, present for miles a sheet of green harvests, but in the hot season, bear the appearance of a desert, without a tree or shrub to relieve its gloomy sameness. The seaward face of the table-land towards the W., though abrupt, is not precipitous, but consists of a succession of terraces or steps. On the Coromandel side the slope to the sea is gentle, exhibiting the alluvial deposits borne down from the higher portions of the table-land.

South-west Frontier of Bengal, including Chota-Nagpoor, Sirgoojah, Palamow, Ramgurh, Hazareebagh, Mynpat, and Amarkantak.

Between 22° 30′ and 24° 30′; and easterly, from about 82° to 85°.

Chota-Nagpoor, 3,000 ft.; hills running E. and W., but of little elevation; Sirgoojah, mountainous, rising 600 to 700 ft. above level of Chota-Nagpoor. Mynpat table-land, about 30 m. S.E. from Sirgoojah town; area not ascertained—about 3,000 or 3,500 ft. Palamow dist., very mountainous—little known. Hazareebagh town, 24°, 85° 54′; 1,750 ft. Slope of country to S., towards Sumbulpoor—N. and E. parts of dist. very mountainous, but level, and even depressed towards Mahanuddy. Sumbulpoor town, only 400 ft. Orissa table-land then rises on the other side of Mahanuddy, in some places to 1,700 ft. backed by the chain of E. Ghauts. Amarkantak, jungly table-land, 22° 40′, 81° 50′; 3,500 ft.

The soil in the plains is generally fertile, producing abundant crops of wheat, barley, rice, pulse, excellent vegetables, cotton, and sugar-cane. The uncultivated parts are overrun with a coarse grass. A great part of the region is quite unknown to us.

Nepaul.

At the foot of the Himalaya range, between Himalaya and the Tarai; 500 m. long; E. to W., 160 m. broad; area, 54,500 sq. m.

The surface generally consists of valleys varying from 4,000 to 6,000 ft. above Bengal plains. Khatmandoo (in an oval-shaped valley 12 m. long), 27° 42, 85° 18′; 4,628. Bhynturee, 29° 34′, 80° 30′; 5,615 ft. Slope to S. drained by Ghogra, Gunduck, and Coosy.

The geological formation of the hilly tract—limestone, hornstone, and conglomerate. Vegetable productions of most remarkable stateliness, beauty, and variety. Climate resembles that of southern Europe.

Table-Lands of Afghanistan and the Countries adjacent to India, on the North-West.

Western Afghanistan.

From about Ghuznee or Sufied-Koh, to Amran Mountains, N. to S.; and from near Kandahar to the Suliman range.

Crest of highland of Ghuznee, lat. 30° 43′, long. 68° 20′; 9,000 ft. Ghuznee, 33° 34′, 68° 18′; 7,726. Yerghuttoo, 33° 20′, 68° 10′; 7,502. Mookur, principal source of Turnak River, 32° 50′, 67° 37′, 7,091. Abistada Lake, 32° 35′, 68°; 7,000. Punguk, 32° 36′, 67° 21′; 6,810. Shuftul, 32° 28′, 67° 12′; 6,514. Sir-i-Asp, 32° 15′, 66° 54′; 5,973. Kelat-i-Giljie, 32° 8′, 66° 45′; 5,773. Julduk, 32°, 66° 28′; 5,396. Hydurzie, 30° 23′, 66° 51′; 5,259. Hykulzie, 30° 32′, 66° 50′; 5,063. Teer-Andaz, 31° 55′, 66° 17′; 4,829. Kandahar, 32° 37′, 65° 28′; 3,484 ft.

Afghanistan, for four-fifths of its extent, is a region of rocks and mountains, interspersed with valleys of great fertility, and in many places containing table-lands, cold, bleak, and barren. It has a surface as rugged as that of Switzerland, with mountain summits of much greater height. General slope of the country, from N.E to S.W.

Northern Afghanistan

Between Hindoo-Koosh on the N., and Sufied-Koh on S.; and Huzareh country on the W., and Khyber hills on the E.

Kurzar, near source of Helmund, 34° 30′, 67° 54′; 10,939 ft. Kalloo, 34° 30′, 67° 56′; 10,883 ft. Youart or Oord, 34° 22′, 68° 11′; 10,618. Gooljatooe, 34° 31′, 68° 5′; 10,500 ft. Shibbertoo, 34° 50′, 67° 20′; 10,500 ft. Siah Sung, 34° 34′, 68° 8′; 10,488 ft. Gurdan Dewar, 34° 25′, 68° 8′; 10,076 ft. Soktah, 34° 40′, 67° 50′; 9,839 ft. Khawak Fort, 35° 38′, 70° 5′; 9,300 ft. Topchee, 34° 45′, 67° 44′; 9,085 ft. Chasgo, 33° 43′, 68° 22′; 8,697 ft. Bamian, 34° 50′, 67° 45′; 8,496 ft. Huftasaya, 33° 49′, 68° 15′; 8,420 ft. Sir-i-Chusma, 34° 21′, 68° 20′; 8,400 ft. Zohak's Fort, 34° 50′, 67° 55′; 8,186 ft. Killa Sher Mahomed, 34° 16′, 68° 45′; 8,051 ft. Kot-i-Asruf, 34° 28′, 68° 35′; 7,749 ft. Maidan, 34° 22′, 68° 43′; 7,747 ft. Urghundee, 34° 30′, 68° 50′; 7,628 ft. Khoord Kabool, 34° 21′, 69° 18′; 7,466 ft. Kabool, 34° 28′, 69°; 6,396. Boothauk, 34° 30′, 69° 15; 6,247 ft. Jugdulluk, 34° 25′, 69° 46′; 5,375. Gundamuk, 34° 17′, 70° 5′; 4,616 ft. Crest of Khyber Pass, 34° 8′, 71° 15; 3,373. Ali-Musjid, 34° 3′, 71° 22′; 2,433 ft. Jellalabad, 34° 25′, 70° 28′; 1,964 ft.

Slope from W. to E.; Kabool River flowing in that direction; lofty mountains enclosing valley of Jellalabad on N. and S. sides. Course of river obstructed, and bed contracted by ridges of rock connecting them. City of Kabool surrounded by hills on three sides. Jellalabad, on a small plain.

Shawl and Pisheen.

Between Hála and Amran ranges, on the N. frontier of Beloochistan.

Khojuck Pass, Amran Mts., 30° 45′, 66° 30′; 7,449 ft. Pisheen, from 5,000 to 6,000 ft. Shawl exceeds 5,000 ft. Town of Shawl, 5,563 ft. Dasht-i-Bedowlat, 30° 57′; about 5,000 ft. Siriab, 30° 3′, 66° 53′; 5,793 ft.

Wildest parts of enclosing mountains,—haunts of wild sheep and goats; more accessible tracts yield pasture for herds and flocks. Orchards numerous. Dasht-i-Bedowlat (*wretched plain*), destitute of water.

Beloochistan.

S. of Afghanistan.

Kelat, 28° 53′, 66° 27′; 6,000 ft. Sohrab, 28° 22′, 66° 9′; 5,800 feet. Munzilgah, 29° 53′, 67°; 5,793 ft. Angeera, 28° 10′, 66° 12′; 5,250 ft. Bapow, 28° 16′, 66° 20′; 5,000. Peesee-Bhent, 28° 10′, 66° 35′; 4,600 ft. Sir-i-Bolan, 29° 50′, 67° 14′; 4,494. Putkee, 28° 5′, 66° 40′; 4,250 ft. Paeesht-Khana, 27° 59′, 66° 47′; 3,500 ft. Nurd, 27° 52′, 66° 54′; 2,850. Ab-i-goom, 29° 46′, 67° 23′; 2,540. Jungikoosht, 27° 55′, 67° 2′; 2,150 ft. Bent-i-Jah, 28° 4′, 67° 10′; 1,850 ft. Bee-bee Nanee, 29° 39′, 67° 28′; 1,695 ft. Kohow, 28° 20′, 67° 12′; 1,250 ft. Gurmab, 29° 36′, 67° 32′; 1,081 ft. Kullar, 28° 18′, 67° 15′; 750 ft.

Coast craggy, but not elevated; in some places a sandy shore; inland surface becomes higher. Most remarkable features of Beloochistan, rugged and elevated surface, barrenness, and deficiency of water. It may be described as a maze of mountains, except on the N.W., in which direction the surface descends to the Great Desert on the S., where a low tract stretches along the sea-shore.

Cashmere and Bultistan, or Little Tibet.

Western Himalaya.

Average elevation of Cashmere valley, between 5,000 and 6,000 ft. above the sea. Huramuk Mt., 13,000. Pir-panjal, 15,000. Small elevations in valley, 250 to 500 ft. Average of valley of Indus (N. of Cashmere vale), 6,600 to 7,000 ft. Slope from S.E to N.W. Mountains on each side rising from 6,000 to 8,000 ft. higher.

Mountains enclosing Cashmere vale, basaltic. Ranges on each side of Bultistan valley rugged, bare, and nearly inaccessible; formation generally of gneiss; that of the valley, shingle and sand.

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WITH

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